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# The Relationship Among Beginning and Advanced American Sign Language Students and Credentialed Interpreters Across Two Domains of Visual Imagery: Vividness and Manipulation

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**THE RELATIONSHIP AMONG BEGINNING AND ADVANCED AMERICAN SIGN  
LANGUAGE STUDENTS AND CREDENTIALLED INTERPRETERS ACROSS TWO  
DOMAINS OF VISUAL IMAGERY: VIVIDNESS AND MANIPULATION**

THE RELATIONSHIP AMONG BEGINNING AND ADVANCED AMERICAN SIGN  
LANGUAGE STUDENTS AND CREDENTIALLED INTERPRETERS ACROSS TWO  
DOMAINS OF VISUAL IMAGERY: VIVIDNESS AND MANIPULATION

A dissertation submitted in partial fulfillment  
of the requirements for the degree of  
Doctor of Philosophy in Rehabilitation

By

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May 2010  
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## ABSTRACT

Given the visual-gestural nature of ASL it is reasonable to assume that visualization abilities may be one predictor of aptitude for learning ASL. This study tested a hypothesis that visualization abilities are a foundational aptitude for learning a signed language and that measurements of these skills will increase as students progress from beginning ASL students to advanced language learners and, ultimately to credentialed interpreters.

Participants in this study consisted of 90 beginning and 66 advanced ASL students in five interpreter education programs in four southern states along with 68 credentialed interpreters. Students and interpreters were administered the *Vividness of Visual Imagery (VVIQ)* self-report questionnaire and the objective *Mental Rotations Test, Version A (MRT-A)*. All ASL students and their instructors were asked to rate students' sign language competency on the *Sign Communication Proficiency Interview Rating Scale*. All participants completed demographic questions regarding their age, gender, ethnicity, parental hearing status, number of years using ASL, number of years working with deaf professionals who use ASL, and their interpreting credential(s).

Students and their instructors rated students' sign communication proficiency similarly. Beginning ASL students were rated significantly lower than the advanced ASL students by both instructors' rating and students' self-rating.

No significant relationships were reported: a) among beginning and advanced students and credentialed interpreters with respect to either the VVIQ or the MRT-A, and b) among the students' VVIQ and MRT-A scores and instructors' ratings on the SCPI. There was suggestive evidence of an increase in mean VVIQ scores from beginning ASL students to advanced ASL students to credentialed interpreters, but not to the level of significance.

When advanced ASL students and lower level state credentialed interpreters were removed from analyses, a significant difference in visual vividness was reported. Nationally certified interpreters scored significantly higher than beginning ASL students on the VVIQ, but not the MRT-A.

This dissertation is approved for  
Recommendation to the  
Graduate Council

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## TABLE OF CONTENTS

CHAPTER ONE: INTRODUCTION	1
ASL is a Visual-Gestural Language	2
Proliferation of ASL Courses	3
Second Language Acquisition and Study of ASL	4
Aptitude for Second Language Learning	4
Aptitude for Sign Language Interpreting	5
Transition from Second Language Learning to Interpretation	5
Theoretical Framework of Visual Imagery	7
Competing Theories	7
Theoretical Framework for this Study	8
The Problem	9
Research Questions	10
Significance of the Study	11
Summary	14
Key Terms	15
Key Abbreviations	16
CHAPTER TWO: LITERATURE REVIEW	18
Visual Imagery and Controllability	18
Visual Imagery and Vividness Defined	18
Visual Imagery Manipulation Defined	19
Relationship between Visual Imagery and Manipulation	20
American Sign Language and Visual Imagery	22
Visual Imagery Studies	24
Memory and Image Vividness	24
Emotion and Image Vividness	24
Age and Imagery Tasks	25
Gender and Imagery Manipulation	26
Influence of Imagery Training	28
Predictors of Second Language Acquisition by Adult Learners	29
Personality Characteristics as Predictors of Success	30
Skill Predictors of Success	34
Measures of Vividness and Control of Mental Imagery	36
Selected Measurement Instruments of Vividness of Imagery	36
Questionnaire on Mental Imagery (QMI)	36
Vividness of Visual Imagery Questionnaire (VVIQ)	36
Vividness of Movement Imagery Questionnaire (VMIQ)	36
Cooper Quality of Imagery Scale (CQIS)	37
Selected Measurement Instruments of Control and Manipulation of Imagery	37
Controllability of Visual Imagery Questionnaire (CVIQ)	37
Controllability of Imagery Questionnaire (CIQ)	37
Selected Tests of Mental Rotation	37

Reliability of Self-Report Questionnaires	38
Summary	40
CHAPTER THREE: METHODOLOGY	41
Research Questions	41
Research Hypotheses	42
Research Design	43
Population and Sample	43
Population	43
Sample	46
IRB Approval and Program Contact	48
Instrumentation	49
Vividness of visual Imagery Questionnaire	50
Revised Vandenberg & Kuse Mental Rotations Test (form MRT-A)	51
Sign Communication Proficiency Interview (SCPI) Rating Scale	53
Procedure with Interpreters	54
Procedure with ASL Students	55
Data Analyses	57
Demographic Data Analyses	57
Instrumental Data Analyses	58
Summary	58
CHAPTER FOUR: RESULTS	61
Demographic Data Analyses	61
Gender	64
Ethnicity	65
Years of Prior ASL Experience	65
Parental Hearing Status	65
Age	66
Years of Prior ASL Experience	67
Years Prior Experience with Deaf Persons who Use ASL	69
Class Status and Students' Self-Rating of Competency on the SCPI Scale	70
Class Status and Instructors' Competency Rating on the SCPI Scale	71
Relationship Between ASL Students' Self-Rating and Instructors' Rating of Students' Language Competency on the SCPI Scale	72
Test Data Analyses	73
Vividness of Visual Imagery Questionnaire (VVIQ)	75
Mental Rotations Test (MRT-A)	77
Instructors' SCPI Scores Correlated with VVIQ and MRT-A	78

VVIQ and MRT-A Association with Instructors' SCPI Ratings and Students' Self-Ratings of Student Communication Proficiency	79
VVIQ and MRT-A Association with Instructors' SCPI Rating of Students' Communication Proficiency	80
VVIQ and MRT-A Association with Students' SCPI Self-Ratings of Their Communication Proficiency	81
Summary	82
CHAPTER FIVE: DISCUSSION	85
Summary of Study	85
Research Questions	86
Relationship Between Students' Vividness and Manipulation of Visual Imagery and Status in University Level ASL Classes	87
Relationship Between Credentialed Interpreters' Vividness and Manipulation of Visual Imagery and that of Beginning and Advanced Students of ASL	87
Relationship Between Students' Vividness and Manipulation of Visual Imagery and ASL Instructor's Evaluation of Students' Sign Communication Proficiency	88
Students' Measures of Imagery and Vividness as a Predictor of Instructors' Rating of Students' Sign Language Competency	88
Discussion	88
Measuring Students' Visual Imagery Skills: Global Construct Or System of Domain Subsets	89
Relationship Between ASL Students' and Instructors' Perception of Language Competency	92
Relationship Between Students' Visualization Scores and ASL Instructor's Evaluation of Students' Sign Communication Proficiency	93
Limitations and Threats to Validity	94
Delimitations	94
Limitations	94
Threats to Validity	96
Recommendations for Future Research	97
Conclusion	101
REFERENCES	102
APPENDICES	112
Appendix A: IRB Approval, University of Arkansas	113
Appendix B: IRB Approval, University of Arkansas at Little Rock	114
Appendix C: Vividness of Visual Imagery Questionnaire	115
Appendix D: Author Permission to Administer the VVIQ	118
Appendix E: Permission from Author to Administer the MRT-A	119

Appendix F: Sample from Vandenberg Test of Mental Rotation (as a representation of the MRT-A)	122
Appendix G: Sign Communication Proficiency Interview (SCPI) Rating Scale	123

## LIST OF TABLES

Table 1.	ASL students in south central region.	45
Table 2.	Description of participants by gender, ethnicity, and parental hearing status	62
Table 3.	Obtained Chi-Square values for each of demographic characteristics.	64
Table 4.	Mean and standard deviation for age.	67
Table 5.	ANOVA summary table for the relationship between class status and age.	67
Table 6.	Mean and standard deviation for number of years prior experience with ASL.	68
Table 7.	ANOVA summary table for the relationship between class status and number of years prior experience with ASL.	69
Table 8.	Mean and standard deviation for number of years prior experience with deaf adults using ASL.	70
Table 9.	ANOVA summary table for the relationship between class status and number of years prior experience with deaf persons using ASL.	70
Table 10.	Mean, standard deviation and confidence intervals for of students' status and self-rating of language competency on the SCPI Scale.	71
Table 11.	Mean, standard deviation and confidence intervals for students' status and teachers' ratings of language competency on the SCPI Scale.	72
Table 12.	Mean, standard deviation, and correlation between students' self-ratings and instructors' ratings for all ASL students.	73
Table 13.	Mean, standard deviation, probability and effect size for the VVIQ with beginning ASL students, advanced ASL students, and interpreters.	75
Table 14.	Mean and standard deviation of beginning ASL students and nationally certified interpreters on the VVIQ.	76

Table 15.	ANOVA summary table for the relationship between class status and VVIQ	76
Table 16.	Means, standard deviation, probability and effect size for the MRT-A with beginning ASL students, advanced ASL students and interpreters.	77
Table 17.	Mean and standard deviation of beginning ASL students and nationally certified interpreters on the MRT-A.	78
Table 18.	ANOVA summary table for the relationship between class status and VVIQ.	78
Table 19.	Correlation between instructors' ratings of beginning students' sign community proficiency and scores on the VVIQ and MRT-A.	79
Table 20.	Correlation between instructors' ratings of advanced students' sign communication proficiency and scores on the VVIQ and MRT-A.	79
Table 21.	Model for prediction of instructors' sign communication proficiency rating from VVIQ Scores and MRT-A Scores (N=156).	80
Table 22.	Model for prediction of students' self-report sign communication proficiency ratings from VVIQ scores and MRT-A scores (N=156).	81

## LIST OF FIGURES

Figure 1.	Status of students/interpreters by gender.	63
Figure 2.	Status of students/interpreters by ethnicity.	63
Figure 3.	Status of students/interpreters by parental hearing status.	64
Figure 4.	Model showing the relationship among variables.	66
Figure 5.	Model showing the relationship between dependent and independent variables.	74
Figure 6.	Model showing the relationship among variables.	80



## **CHAPTER ONE: INTRODUCTION**

Teachers of American Sign Language (ASL) recognize that beginning students enrolled in university courses exhibit a wide range of abilities to quickly and accurately learn the language. Some students learn and progress easily while others, despite strong interest, struggle with the language and never acquire mastery. Research on cognitive and performance predictors of success in learning sign language and interpreting is emerging. Still, the field of sign language interpreter education can neither define a set of qualities or characteristics that identify distinguishing characteristics of successful sign language interpreters (Seal, 2004) nor determine foundational aptitude for learning a signed language (Macnamara, 2009, 2008). Consequently, an important goal is to identify the distinguishing characteristics of beginning ASL students who are successful in learning the language.

Given its visual nature, the ability to visualize may be a tool to facilitate and enhance the learning of a visual-gestural language. Presumably, then, there will be a benefit to investigating the visual abilities of sign language students during their language learning progression. The need to investigate visualization ability as a possible foundational aptitude for learning sign language is based on three considerations: (a) the visual-gestural nature of ASL and how it differs from spoken language (Baker & Cokely, 1980; Emmorey, 2002), (b) the recent growth of American Sign Language courses at colleges and universities (Furman, Goldberg, & Lusin, 2006; Quinto-Pozos, 2005), and (c) research on second language learning and ASL study that supports the importance of identifying foundational aptitude for language learning (Gan, Humphreys, & Hamp-Lyons, 2004; Onwuegbuzie, Bailey, & Daley, 2001; Stone, 2008).

In this chapter the three issues above will be more fully developed followed by a statement of the problem, the research questions, and the significance of the study. A theoretical framework of visual ability will provide the structure in which this study is situated. This study seeks to determine if there is a significant difference in visualization skills among beginning and advanced ASL students within college and university programs and credentialed interpreters in order to further the discussion of foundational skills contributing to the potential for success in learning ASL.

### ASL is a Visual-Gestural Language

The process of learning and using ASL is different than for a spoken language. Whereas spoken English is an oral/auditory language, American Sign Language is, by definition, a visual-gestural language with its own grammar and syntax used by the American Deaf Community (Baker & Cokely, 1980). This definition is as current today as when it was first published 30 years ago.

The language is produced gesturally and received visually. Signs are defined by the parameters of handshape, placement, spatial orientation, and movement (Baker & Cokely, 1980). The position of the hands demonstrates spatially the relationship between objects (Emmorey et al., 2005). Variation of meaning (ex: angry, furious) can be presented by sign intensity and grammatical features that are displayed on face and body (ex: a question or statement).

Signed languages involve mental imagery. The ability to generate, maintain, and rotate visual images is integral to ASL production and comprehension (Emmorey, Kosslyn, & Bellugi, 1993). According to Emmorey (2002), a leading researcher in mental imagery and sign languages, "Signed languages are articulated by movements of the hands, face, and

body, and the effects of mental imagery ...can be directly observed within many linguistic domains” (p. 50).

### Proliferation of ASL Courses

Courses in American Sign Language (ASL) are growing rapidly with students enrolling in ASL courses in record numbers (Quinto-Pozos, 2005). This growth is fueled in part by the increasing number of students entering the field of sign language interpretation. The majority of these students today are hearing individuals who learn ASL as a second language with no family ties to persons who are deaf.

Welles (2004) reported results of a Modern Language Association (MLA) survey of two- and four-year institutions of higher education enrollment in Fall 2002 for non-English language courses. ASL was reported as the fifth most commonly studied language (behind Spanish, French, German, and Italian) with almost 61,000 students enrolled in ASL courses equaling 4.4% of all language students reported. The MLA study of language enrollment (other than English) in 2006 reported that ASL had surpassed Italian to be ranked 4<sup>th</sup> with an enrollment increase of 29.7% over 2002 enrollment figures.

Focusing on two-year colleges only, ASL ranked second among languages studied surpassed only by Spanish. (Furman, Goldberg, & Lusin, 2007). Clearly enrollment has increased tremendously since 1990 when institutions first began reporting numbers of students studying ASL (Welles, 2004). Many of these universities, similar to the University of Arkansas at Little Rock (UALR), offer ASL not only as part of their interpreting degree coursework, but also to meet university second language requirements, minor studies, and as elective courses. Beginning ASL classes provide the opportunity for interpreter education programs to recruit new majors into the field of sign language interpretation.

## Second Language Acquisition and Study of ASL

Although the process of learning and using ASL is different than for a spoken language, there are similarities across all language learning. The literature on cognitive abilities and skills in spoken language learning and adult second language learning theory provides insight into prerequisite skills for learning language. These fields of study will not provide all the answers as they do not take into account that ASL is a visual-gestural language, different in structure and delivery from aural-oral languages students are accustomed to speaking and studying.

### *Aptitude for Second Language Learning*

There is a body of work investigating psychological factors influencing second language learning such as *motivation*, *self-confidence*, *language anxiety*, etc. For example, Gan et al. (2004) studied Chinese university students studying English. They compared successful second language learners to unsuccessful language learners. *Self-management*, *internal motivation* from positive language learning experiences, and *self-efficacy* for language learning were some of the characteristic differences between these groups of students.

Onwuegbuzie et al. (2001), studying university students enrolled in foreign language classes, reported foreign-language *anxiety* as the second best predictor of foreign language achievement (academic achievement was first). Foss and Reitzel (1998) developed exercises within a relational model of communication competence to manage second language learning anxiety.

### *Aptitude for Sign Language Interpreting*

Recent U.S. and international studies have researched factors influencing skill in sign language interpreting. In 2004, Seal investigated differences in cognitive, motor, attention, and personality attributes among interpreters at different credential levels. She reported that one attribute, *abstract reasoning*, tested high in 18 of 28 interpreters.

Gómez, Molina, Benítez, and Santiago (2007) of the University of Granada investigated personality, perceptual-motor, and cognitive factors that may contribute to both learning sign language and developing sign language interpreting skills. They determined that while personality characteristics are less important than cognitive skills, still, *dominance* (i.e., the ability to cope, not be intimidated easily, tenacious, assertive, and self confident) is related to sign language interpreting skills achievement.

Bontempo (2008) conducted a study of factors from social-cognitive theory among Australian sign language interpreters. Her study reported that *goal orientation*, *self-efficacy*, and *affectivity* (i.e., emotional stability) accounted for 9% of the rating variance in interpreter competence.

Currently Stone (2009) is comparing expert sign language interpreters to interpreting students in an undergraduate training programs in the United Kingdom. His study is using selective tests to identify aptitude in general language and specific modality, i.e., spoken language vs. signed language. His study is not yet complete.

### *Transition from Second Language Learning to Interpretation*

Studies on successful transition from language learning to interpretation coursework have been few, especially in the field of sign language interpreting. A study by Shaw, Grbic, and Franklin (2004) addressed spoken and signed language interpreting students' study skills,

processing abilities, and personality characteristics thought to be important for transition from language learning to interpretation. They reported that *confidence* and *risk-taking* were primary personality assets for students transitioning from language studies to interpreting courses.

A further study by Stauffer and Shaw (2006) investigated 16 personality traits influencing success of spoken language and sign language interpretation students as perceived by the students. Results indicated a moderately significant relationship with one variable, *patient*, and a weak relationship with three additional variables: *curious*, *accepting of instructor feedback*, and *comfortable in groups*.

No studies to date have investigated the relationship between the strength of beginning ASL students' ability to visualize and their progress through sequential ASL classes. Some research has been conducted on the visual nature of ASL. Liddell (1990) in his investigation of the use of space in ASL, particularly with verb agreement, provides a description of how non-present referents are represented (i.e., when talking about a person or thing that is not in the immediate environment). He describes this process as the signer "imagining" (creating a mental image) the referent(s) to be present and directing verb action toward the imagined referent's location. Emmorey and Kosslyn (1996) and Emmorey (2004) further expand on the visual nature of ASL and Liddell's work. "In addition, ASL classifier verbs of location and motion often require precise representation of visual-spatial relations within a scene, and such explicit encoding may require one to generate detailed visual images" (Emmorey, 2004, p. 263).

## Theoretical Framework of Visual Imagery

### *Competing Theories*

People use visual imagery everyday to perform routine tasks such as in recall, problem solving and creative imaginings. For example, visual imagery is used for recalling information for tests, determining if a car will squeeze into a space, mentally comparing colors or rotating objects (such as furniture) while shopping, visualizing a close friend, or mentally practicing by “watching” a baseball being hit into the air and following the trajectory of the ball (Kosslyn, Thompson, & Ganis, 2006; Marks, 1999; Pylyshyn, 2003). There are varying theories of mental imagery as part of the larger body of cognitive theory (Kosslyn, 1994; Thomas, 1999). During the 1970s and 1980s, scientists debated whether mental imagery is the creation of internal pictures, i.e., *pictorial theory*, or whether imagery is a form of subjective experience, i.e. *experiential theory* (Mental Imagery, 2005). The pictorial theorists believe that mental actions such as visual scanning, estimating relative distance, and directions are better explained by “picture-like” representations. The experiential theorists, on the other hand, define mental imagery as a form of subjective imagery experiences represented and stored internally. One characteristic that both theories share in common is that imagery, whether real or unreal, is intentional (Mental Imagery, 2005).

In 1998 Morin suggested another theory – *mental mediation theory* --that mental imagery mediates self-awareness and self-information; that is, imagery enables individuals to see themselves behaving as others might see their behavior. Abell and Currie (1999) describe *mental simulation theory* whereby individuals “imagine” themselves in several situations and “see” the consequences of their choices before taking action. Mental imagery simulation

contains a manipulative component that includes changing perspective and action. In this theory mental rotation involves mentally simulating an image revolving or mentally reaching out and rotating an object.

Another earlier mental imagery theory, *functional equivalence*, is based on cognitive theory and is applicable to this study. This theory proposes that mental imagery is retrieved into consciousness from long-term memory similar to how perceptual objects are processed by sight (Marks, 1977; Kosslyn, 1980). According to the theory, the more details, color, size, shape, and movement of visual information input, the more vivid the mental image will be (Marks, 1999). Marks, however, reports some drawbacks of cognitive theories of mental imagery including the lack of focus on the role of emotion, motives, and goals.

Kosslyn (1980) proposed a theory of visual representation with two levels: "... deep non-pictorial representations and surface representations (patterns) in a visual buffer" (as cited by Chandrasekaran & Narayanan, 1990, p. 6). Thomas (1999) added to Kosslyn's work and developed a *quasi-pictorial theory of imagery* retaining the two levels. One level is a "deep representation" which is not experienced directly and is abstract. The other is "surface representation" which is pictorial. The two representations work together whereby images are generated and compared with or transformed from deep structure. In other words, the eye perceives and generates an image that is compared to deep representations stored in long-term memory and influenced by the mind's interpretation of what it sees.

#### *Theoretical Framework for this Study*

A combination of the work by Morin (1988), Marks (1977), and Kosslyn (1980) forms the theoretical framework for this study. Visual imagery is a function of mental picture generation formed from perception and compared with representations held in long-term



memory. These images become more vivid and have greater clarity when input is richer. Visual imagery includes the ability to create and manipulate images, perspective and actions. They are both intentional (can be created for a purpose) and voluntary (can be called at will). Visual images can be accessed from memory (compared to deep representation) or newly created (transformed from deep representation). It appears reasonable to assume, then, that the more vivid students' visual imageries are, and the greater their ability to create and manipulate mental images, the more these skills are available to students to apply to learning ASL given the visual requirements of the language as noted earlier.

### The Problem

In 1987, Robinson, an interpreter educator, noted that she had students who could not visualize effectively. She proposed mental imagery strategies and exercises to assist students in the interpretation process. Her focus on the importance of visualization skills was validated 21 years later by Macnamara (2008) who reported that “visual attention, visual representation, spatial representation, visual memory, and visualization manipulation abilities are integral to the interpreting process” (p. 36).

In my own teaching over the past 23 years, I have noted that ASL students have more success expressing themselves in ASL when they work from visual pictures into ASL (visual to visual) than when they process the picture first sub-vocally through English. It appears that working from visual (picture) to visual (ASL) is a successful teaching technique IF the students have strong visual abilities (Stauffer, 1992).

Given the visual characteristics of ASL, the ability to visualize may be linguistically required for successful learning of a signed language and interpreting such as in the use of referencing (pointing to a person present or set up on space), classifiers (handshapes that

represent people or things and show relationship and movement), rotation (ex: signer's perspective), narrative shifts (as in first person discourse), mapping (mental organization of information), perspective, etc. (Emmorey et al., 1993). However, visual imagery skills are usually "...not directly assessed nor taught in sign language or interpreting classes, but rather are learned intuitively as mastery of ASL is obtained" (Stauffer, 1992, p. 62). If, indeed, students are developing visual imagery skills, there are no standard measures of their ability to visualize, no studies of the quality of the visual imageries these students produce, nor studies of the students' ability to manipulate these images. Additionally there is no body of work investigating whether visualization ability is a foundational aptitude for learning a signed language, nor any research on factors that might contribute to the strengthening of students' visual abilities.

### Research Questions

This study seeks to investigate visualization skills across two domains -- vividness and ability to manipulate visual imagery -- in ASL students who are enrolled in university semester-long courses of beginning and advanced ASL and in credentialed interpreters. The following research questions are addressed: What is the relationship between students' vividness and manipulation of visual imagery and progress in university level American Sign Language (ASL) classes? What is the relationship between ASL students' and credentialed interpreters' vividness and manipulation of visual imagery? Can measures of visual vividness and manipulation predict instructors' rating of students' sign language competency? What is the relationship between students and instructors on their rating of students' language competency?

The primary hypotheses underlying these research questions are that advanced ASL students score significantly higher than beginning ASL students on tests of mental imagery abilities, and, by extension, credentialed interpreters score higher than beginning and advanced ASL students on test of mental imagery abilities. The null hypothesis is that there is no difference between beginning students, advanced students, and credentialed interpreters in their ability to visualize as reflected in the scores on these measures. A second hypothesis is that scores on measures of visual ability predict instructors' rating of students' sign language competency. The null hypothesis is that that there is no relationship between student scores and instructors' ratings. A third hypothesis is that students' self-rating of language competency correlate with their instructors' rating of language competency. The null hypothesis is that there is no relationship between students and instructors on ratings of student language competency.

### Significance of the Study

The primary purpose of this study is to investigate the relationship between ASL students' ability to visualize and their status in ASL coursework. Do students who have the ability to visualize experience success in ASL language classes? Is there a relationship between students' ability to visualize and their successful transition from beginning language to advanced language classes?

Postsecondary ASL studies address linguistic development, visual-perceptual and visual-motor skills as well as cultural knowledge and attitudes. To date, students' success is determined by trial and error. They begin with ASL I, and if they are successful, proceed to ASL II. Students who struggle with language learning may need to repeat a course before continuing in sequence. Some students may not succeed despite a strong desire and several

attempts to learn the language, eventually dropping out or transferring to another major.

There are currently no standardized measures of ASL aptitude to guide faculty when advising students as to their potential for success in an ASL studies program. Macnamara (2008), although speaking of sign language interpreter education, best describes this problem that is equally applicable to sign language study:

The wide range of individual aptitudes among sign language interpreters, as well as the range of success rates among interpreting students, gives cause to investigate the reasons for such differences... Within the field of sign language interpreting, there is a paucity of tools for assessing interpreter aptitude. Because of this paucity, several negative situations can occur a) Prospective interpreters have little way of knowing whether or not they will become successful interpreters and invest a great deal of time and money on education and training that may not lead to a career, or may lead to an unsatisfying career, b) interpreter educators make subjective judgments about students' potential and encourage some students to withdraw from programs even when those students may have the potential to be successful interpreters, and c) some students are passed through their courses even though they do not have the aptitude to become skilled interpreters (p. 34).

The advising issue becomes critical with universities moving to guarantee contractually entering freshman students completion of a baccalaureate degree in four years, assuming successful completion of courses and course sequencing. For example, Arkansas' 85<sup>th</sup> General Assembly of 2005 passed *Act 1014* which states that, "The purpose of this act is to ensure that faculty advisors at universities provide students with course selection advice that will enable a full-time student to obtain most bachelor's degrees within eight (8) semesters" (UALR Provost's Office, 2008, ¶1).

In 2009 Arkansas' Governor, Mike Beebe, proposed to adjust the higher education funding formula to be based on number of graduates rather than number of students enrolled in classes creating a financial incentive for universities to increase graduation rates (Beebe, 2009). As these trends continue, programs will need better ways to advise students regarding

their potential for program success and to reduce attrition while increasing graduation rates. Coursework “trial and error” is not effective for students, academic programs, or colleges and universities. It is imperative that programs establish better advising methods based on valid research of prerequisite abilities and foundational aptitudes for language acquisition and progressive skill development.

If students who succeed in ASL exhibit strong visual abilities then this may be one component that can be measured early in the language sequence and made available to potential students. Assessment of students’ ability to visualize including the quality, control, and manipulation of visual imagery may add to the body of knowledge that program faculty can use to target students for recruitment into ASL studies or interpreter education programs. This information may also assist programs during advisement of students early in their second language learning sequence who seek ASL/English interpretation as a major and a career.

Lastly, if visualization skills prove to be one foundational aptitude for learning a signed language, then this information can inform curricular design. According to Sawyer and Ranta (2001), there is a relationship among language aptitude, individual differences and instructional treatments. These authors state, “...many more studies [are needed] of how aptitude differences affect the outcome of instruction in general and specific language learning tasks in particular” (p. 352). In other words, if visualization is a key to learning a signed language, then visualization skill development may be useful to address in ASL curricula design and in classroom instruction.

## Summary

American Sign Language is one of the most commonly studied languages in colleges and universities today, second only to Spanish at two-year colleges. ASL is a visual-gestural language different in mode and learning style than English that requires aural-oral skills. There are no known published studies of the visual imagery abilities of students studying American Sign Language, although there are some reported studies of hearing users of ASL and visual imagery. Some studies of second language learning aptitude are applicable to learning sign language; however, they do not address the visual or motor skills of a signed language. Currently success in ASL coursework is by trial and error; some students succeed and others do not despite desire and commitment. Given the visual-gestural nature of ASL it is reasonable to assume that visualization abilities may be one component of aptitude for learning ASL. Imagery theory suggests that visual imagery quality is based on the strength of perception and deeply stored representation, and that imagery is available for recall and transformation.

This study proposes the criticality of visual abilities as a foundational aptitude to learning ASL and interpreting. On that assumption, this study seeks to measure visual abilities of ASL students and credentialed interpreters to investigate differences among beginning ASL students, advanced ASL students, and credentialed interpreters. The hypothesis is that advanced ASL students score significantly higher than beginning students on tests of mental imagery abilities, and by extension, credentialed interpreters score higher than both beginning and advanced ASL students on these measures. Results of this study may inform student advisement, potential student recruitment, and ASL curricular design.

## Key Terms

For the purpose of the study, the following definitions apply:

*American Sign Language* – a visual-gestural language that has its own grammar and structure used by the American Deaf Community (Baker & Cokely, 1980; Isenhath, 1990).

*Aptitude* - the potential natural ability for learning

*L1* – first or native language

*L2* – second language acquired

*Manipulation of visual imagery* - controllability of changes in mental images, or mental efficiency (Griffitts, 1927 as cited in Richardson, 1969)

*Mental rotation* – mental manipulating an object so that it can be seen viewed from different angles, different perspectives without distortion to the original shape

*Referent in ASL* - linguistic structure of setting up a location in space and then pointing to the space in discourse when talking about a person or thing that is not in the immediate environment (Taub, Galvan, Piñar, & Mather, 2006a)

*Spatial ability* – “the ability to represent and transform symbolic or nonlinguistic information through space” including spatial perception, mental rotation, and spatial visualization (Chan, 2007, p. 278)

*Visual imagery* - the ability to create and manipulate visual images in the mind (Marks, 1972, McKim, 1972)

*Vividness of visual imagery* - the richness in detail contained in the representations from which images are generated (Baddeley & Andrade, 2000; D’Angiulli & Reeves, 2002)

## Key Abbreviations

ACTFL - American Council on the Teaching of Foreign Languages

ARID – Arkansas (chapter) Registry of Interpreters for the Deaf

ASL – American Sign Language

CIQ - Controllability of Imagery Questionnaire

CQIS - Cooper Quality of Imagery Scale

CVIQ - Controllability of Visual Imagery Questionnaire

EIPA – Educational Interpreter Performance Assessment

FLLD - foreign language learning disability

MAB-II - Multidimensional Aptitude Battery II

MLA – Modern Language Association of America

MRT– Mental Rotations Test, versions A, B, C, D

NAD – National Association of the Deaf

NCIEC – National Consortium of Interpreter Education Centers

NIEC – National Interpreter Education Center (at Northeastern University, Boston, MA)

QAST – Mid-America Quality Assurance Screening Test

QMI - Questionnaire on Mental Imagery

RID – Registry of Interpreters for the Deaf

RSA – Rehabilitation Services Administration

SCPI – Sign Communication Proficiency Interview

TVIC - Test of Visual Imagery Control

UARK – University of Arkansas (Fayetteville)

UALR – University of Arkansas at Little Rock



VMIQ - Vividness of Movement Imagery Questionnaire

VVIQ – Vividness of Visual Imagery Questionnaire

## CHAPTER TWO: LITERATURE REVIEW

The purpose of this chapter is to review the literature related to this study. For organizational purposes, this literature review is organized under five headings. These include (a) visual imagery and controllability, (b) visual imagery and American Sign Language, (c) visual imagery studies, (d) predictors of successful acquisition of ASL by adult learners, and (e) measures of vividness and control of mental imagery.

A review of the literature was conducted to examine studies of visual imagery abilities of various populations. An electronic search was conducted for articles during the last 25 years available either on-line or through the UALR and UA Fayetteville libraries using Academic Search Complete, Education Research Complete, Academic Search Elite, Professional Development Collection, SocINDEX with Full Text, PsycArticles, CINAHL with Full Text, PsycINFO, and thesis and dissertation databases. References were searched via Google and Google Scholar. Additionally, books, conference proceedings, internet sources, and reference lists from pertinent articles were reviewed for further resources.

### Visual Imagery and Controllability

#### *Visual Imagery and Vividness Defined*

Visual imagery is defined as the ability to create and manipulate visual images in the mind (Marks, 1972; McKim, 1972). Said another way, visual imagery refers to an individual's ability to mentally represent experiences that are neither physically present nor sensory stimulated from the outside world (Matlin, 1989 as cited in Cooper, 2004; Morin, 1998; Richardson, 1994). These experiences are familiar to most adults, occur spontaneously, and can be produced with varying degrees of vividness and control over its

content (Richard, 1994). More colloquially said, visual imagery is seeing with the “mind’s eye.”

Mental images vary by nature. Some imagery types include *hypnagogic and hypnopompic imagery* (images created right before and after sleep), *hallucinations* (images seen as real and external but created internally), *eidetic imagery* (photographic memory), *memory* (recalling of past events), *imagination, fantasy, and daydreams* (images without an actual referent), *dreams* (images created during sleep), and *symbolic imagery* (images for abstract concepts such as time) (French, 1902; Robinson, 1987; Samuels & Samuels, 1975). Some images are controllable (e.g., fantasy, daydreams) while others are uncontrollable (e.g., hallucinations, dreams).

Vividness is the richness in detail contained in the representations from which images are generated (Baddeley & Andrade, 2000; D’Angiulli & Reeves, 2002). More precisely, vividness is defined as a combination of *clarity* (brightness of color, sharpness of outline and details) and *liveliness* (how dynamic, vigorous, and alive the image is) (Marks, 1972, 1999; McKelvie, 1995). According to Marks (1999), “the empirical evidence provided by a comprehensive meta-analysis [by McKelvie in 1995]... is strongly supportive of this perceptual definition of imagery vividness” (p. 570). A vivid image places the imager in the imaged situation as if it was real and includes meaning, liveliness and strength together with vigor and intensity (Richardson, 1994).

#### *Visual Imagery Manipulation Defined*

Manipulation of visual imagery is defined as controllability of changes in mental images, or mental efficiency (Griffitts, 1927 as cited in Richardson, 1969). Imagery manipulation requires an individual to perform mental tasks such as spatial orientation of

objects in relation to one's own body and the ability "...to move, rotate, turn, twist, or invert one or more objects" (Richardson, 1969, p. 54). Imagery manipulation is a more complex task than simply the creation of a mental image, no matter how vivid or detailed.

### *Relationship between Visual Imagery and Manipulation*

Imagery generation pervades everyday life (Finke, 1989; McKim, 1972). People routinely apply visual thinking to solve common problems such as *how many lights are there before I turn left? What clothes shall I wear tomorrow? How well will a new football strategy work?* Some professions such as air traffic controllers and pilots require high-level performance of perceptual motor skills and display significantly more vivid imagery than their matched control subjects (Isaac & Marks, 1994). Others may be less visual. W. Grey Walter (1963) reported that about one-sixth of the general population is highly visual, another one-sixth of the general population does not use visual images unless required to, and two-thirds of the general population is able to regularly evoke visual images.

Guided imagery generation is used widely as a therapy technique for improved health and wellness. A perusal of professional article titles in EBSCO on mental imagery and therapy finds applicability to such diverse needs as overcoming depression; pain reduction for cancer, arthritis, phantom pain and control of asthma; reduction of anxiety and stress; self management and increase in self-esteem; art therapy with children; and relearning by patients after a stroke.

People are not limited to only visualizing an object or observing motion. Individuals can visualize an object or a scene from different perspectives that require rotation or viewing from opposite directions. For example people can reflect on life events most often viewing them from first-person perspective, that is, as they originally saw them. The same events,

however, can be viewed from a third-person perspective such as an observer would have seen the events transpire. While first-person perspective is more common, most people can shift between perspectives at will (Libby & Eibach, 2008).

Image generation is an internal event; therefore, tools to measure strength of image generation are subjective and focus on an aspect of imagery such as *vividness*. Studies of manipulation of imagery can be subjective (ex: Gordon Test of Mental Imagery Control) or objective such as mental rotations tests. Most studies attempting to link objective and subjective measures of mental imagery have not shown a strong relationship between subjective questionnaires and objective measures (DiVesta, Ingersoll, & Sunshine, 1971; Lequerica, Rapport, Axelrod, Telmet, & Whitman, 2002; Richardson, 1977). Lequerica, et al. (2002) report that one problem may be that questionnaires often require test subjects to generate a mental image for manipulation in response to a verbal prompt (ex: “*visualize a car rolling down a hill*”), where objective measures of mental manipulation, such as mental rotations tests, present an image to the subject.

While measurement tools may not show strong relationships, individuals’ ability to create and manipulate images may, in fact, be strong. Researchers report that some individuals have both strong mental imagery generation and controllability skills, while others can create strong mental images but have poor control. Those with weak control may also exhibit weak ability to create visual images. Richardson (1969) reports:

It is now evident that some of those with vivid imagery may find such imagery impossible to control (e.g., Start & Richardson, 1964), and that poor control may also arise when imagery is weak and evanescent. The logical consequence of this latter occurrence is the low but positive correlation that is often found between measures of vividness and measures of control (p. 9).

Interest in measuring the ability to generate and manipulate mental imagery continues. The study of creating and manipulating mental imagery has become a legitimate focus for sports psychology whereby athletes use mental practice to enhance sports achievement (Cooper, 2004). Athletes are taught to visualize themselves participating successfully in an event as part of practice and warm-up activities. Interest is increasing in measuring and enhancing athletes' abilities to visualize. For example, Cooper (2004) developed and validated the Cooper Quality of Imagery Scale (CQIS), an online instrument to measure vividness of sporting mental imagery.

#### American Sign Language and Visual Imagery

Researchers have investigated the visual nature of ASL. Emmorey, et al. (1993) conducted a study of visual imagery and visual-spatial language among deaf ASL signers, hearing non-signers, and hearing signers (i.e., person who have deaf parents, learned ASL as their first language, and continue to use ASL in their daily lives). The researchers hypothesized that "certain imagery abilities are integral to the production and comprehension of ASL...Specifically they hypothesized that during discourse signers generate images...and then transform these images in various ways particularly by shifting reference and perspective" (Emmorey & Kosslyn, 1996, p. 29). Their study investigated image generation, image maintenance, and mental rotation--three abilities they purport are important to ASL production and comprehension. Although results reported no group differences in the groups' ability to maintain or rotate images, results did indicate that hearing signers have increased ability in image generation:

ASL signers are better than non-signers in specific aspects of visual mental imagery. Indeed, we found that both deaf and hearing signers have an enhanced ability to generate visual mental images...Signers' enhanced visual

imagery abilities may be tied to specific linguistic requirements...(Emmorey, et al., 1993, p.176).

Talbot and Haude (1993) conducted a study of 51 women to investigate the relationship between the amount of experience and skill in ASL and performance on the Mental Rotations Test. In contrast to the Emmorey, et al. (1993) study, this study reported that experience or instruction in ASL significantly related to Mental Rotations Test performance, with female ASL users performing better than women with less skill, training, or experience in ASL.

In 1996, Emmorey and Kosslyn investigated the abilities of deaf ASL signers and hearing non-signers. The authors investigated whether deaf ASL signers' and hearing non-signers' process of imagery generation took place on the same brain hemisphere. In this study, 20 deaf native ASL signers (mean age of 26 years) and 20 hearing non-signers (mean age of 22 years) who were all right handed, were asked to memorize block upper case and lower case letters presented in grids or brackets. After trial practice each respondent was asked to encode a prompted image in an otherwise empty grid or set of brackets to the left or right of a centrally fixed point and compare the prompt to the fixed point. Results indicated that deaf subjects who use ASL as their primary language generated visual mental images faster than hearing non-signing subjects when information was presented to the right hemisphere of the brain. Differences were evidenced between deaf and hearing subjects regarding hemispheric processing for spatial relations representation. Hearing non-signers generated images better when the images were cued to the left hemisphere. The authors proposed that "The role of the right hemisphere in these language-linked processes may also lead to a right hemisphere dominance for generating images" (Emmorey & Kosslyn, 1996, p. 43).

## Visual Imagery Studies

Researchers have conducted studies of various hypotheses of imagery creation and manipulation, and influences of vividness of visual imagery on such factors as memory, emotion, and age. Results from studies indicate that imagery can be affected by diverse factors. Additionally, studies report that vividness of visual imagery varies among individuals.

### *Memory and Image Vividness*

A study by Baddeley and Andrade (2000) investigated the relationship between memory and imagery vividness. The authors hypothesized that imagery vividness “reflects the richness of representations in working memory” (p. 128). The authors concluded from their study that both long-term and working memory influence vividness of imagery and further hypothesized that vividness of imagery is determined by the amount of information available in any memory system” (p. 141).

### *Emotion and Image Vividness*

In 2004, Bywaters, Andrade, and Turpin investigated the influence of emotion on imagery vividness. In one study, undergraduate students were exposed to pictures that were rated according to valence (power), arousal, and emotionality. These images were later recalled and rated for vividness. Results indicated that images created from pictures with strong valence (i.e. highly pleasant and highly unpleasant) were more vivid than images created from neutral pictures. There were also strong correlations reported between both arousal and vividness and overall emotionality and vividness, suggesting that imagery stimulus, emotional status, and type of memory (short-term vs. long-term) affect vividness of visual imagery.



### *Age and Imagery Tasks*

Craik and Dirkx (1992) studied possible relationships between age and ability to create and manipulate mental images. In two similar experiments younger subjects (mean age 22.6 years in both experiments) and older subjects (mean age 69.9 years in the first experiment and 71.6 years in the second experiment) participated in three tests involving manipulation of mental imagery. Results indicated that age was related to decrements in older subjects' ability to perform tasks of mental imagery, decreasing both speed and accuracy of responses.

A study by Dror and Kosslyn (1994) investigated the effect of aging on image generation, image maintenance, image inspection, and image transformation. Younger subjects (mean age 20 years) and older subjects (mean age 63 years) were tested on the above four imagery tasks. Results indicated that age does not affect visual imagery uniformly, with some processes more impaired than other. Older subjects were similar to the younger subjects in two tasks, adding segments to an image and their ability to scan images; however, the older subjects' ability to rotate mental objects and to generate and retrieve complex images as well as maintain images degraded by aging.

Briggs, Raz, and Marks (1999) studied the relationship between age and information processing in mental imagery tasks with 85 healthy adults ages 18 to 77 years. The researchers hypothesized that response time would increase significantly as age increased for tasks requiring imagery generation and manipulation than for more simple visual-perceptual tasks. The researchers proposed a second hypothesis that slowing of information processing is related to the reduction of working memory and sensorimotor speed as age increases. To test these hypotheses, participants were administered four increasingly difficult mental

imagery and perception tasks including perception, image generation, image rotation, and image generation with rotation. Results indicated that age significantly related to declines in processing speed of visual stimuli and related mental images, and with greater complexity of task leading to increased errors. For perception tasks, there were no observed effects of age.

### *Gender and Imagery Manipulation*

The influence of gender on tests of spatial tasks has consistently shown men to perform better than women while women consistently perform better than men on tests of verbal fluency (Burton, Henninger, & Hafetz, 2005). Studies attributed these gender differences to a variety of factors. One hypothesis attributes gender differences to prenatal hormonal differences predisposing males to higher level of androgens that influence spatial skills such as mental rotation (Burton, Henninger, & Hafetz, 2005). Other studies suggest that social conditioning encourages boys to study math and science while not encouraging girls similarly (i.e., a null educational environment for girls), and girls' reduced exposure to spatial tasks and professions requiring such abilities (Betz, 2005).

Finger-length ratios (second to fourth fingers, second to fifth fingers, and third to fourth fingers) are believed to be gender related differences in spatial performance. In a study of 134 university students at Fordham University (93 female and 41 male), Burton, Henninger, and Hafetz (2005) compared finger-length ratios with students' spatial abilities, verbal fluency, and verbal SAT scores. Results indicated a curvilinear relationship between spatial abilities and male finger-length ratios. In other words, men with very masculine finger-length ratios or very low finger-length ratios, scored higher on tests of spatial ability than women (as tested by the Vandenberg Test of Mental Rotation). Women with female finger-length ratios, i.e., lower levels of testosterone, scored higher on tests of verbal

abilities; however, women with more masculine finger-length ratios, i.e. higher levels of testosterone, scored higher on tests of spatial ability than those with lower levels of testosterone. These results support previous findings in the literature.

A study of 337 gifted Chinese students grades 3-12 (112 boys and 125 girls) reported clear gender differences in spatial ability, especially mental rotation. Students were given the spatial test of the Multidimensional Aptitude Battery II (MAB-II) to measure spatial ability, particularly mental rotation using two-dimensional space. Students took the 50-item test asking them to compare a criterion figure on the left to five rotated figures on the right and determine which of the figures matched the criterion figure in shape. Students also completed a six-item questionnaire rating their spatial experiences. Results of analysis reported significant differences for gender in spatial ability, especially mental rotation, with males scoring significantly higher than females, similar to previous studies. The authors point out that "...variables such as rate of maturation, cerebral lateralization, sex hormones, differential experience and socialization, and gender-role identification have all been considered relevant" in explaining these gender differences (Chan, 2007, p. 279). Further findings suggest that spatial experience can positively influence spatial ability.

A 2003 study by Brownlow, McPheron, and Acks investigated science background and spatial abilities in men and women. Mental rotation ability was assessed with the Purdue Visual Rotations Test in three groups of university students (N=129): those with no college background in science, those with limited background in science in college, and those with extensive background in science in college. The authors reported that men and women with no college background in science and men and women with extensive college background in science scored statistically comparable on the test of mental rotation. Men outperformed

women when both had limited college background in science. It was acknowledged that gender bias regarding the appropriateness of science as a career choice for men may have influenced the results. “Because MR [mental rotation] ability is crucial to success in different types of courses and in several lucrative careers, an understanding of those environmental factors that exacerbate or attenuate women’s MR capabilities is paramount” (Brownlow, et al., 2003, p. 371).

### *Influence of Imagery Training*

According to Pérez-Fabello and Campos (2007), “Art creation often involves the use of mental images” (p. 227), and that mental creativity is a human ability that can be enhanced rather than an immutable inherent talent. The authors’ review of the literature provided mixed results from artistic or creativity training. Some studies report that training in art does increase mental imagery capacity (Zenmore, 1995 as cited in Perez-Fabello & Campos, 2007), while other studies of training in mental imaging were found to be less effective than cognitive training (Scott, Leritz & Mumford, 2004 as cited in Perez-Fabello & Campos, 2007).

The authors conducted a study of 91 females and 35 males to determine if fine arts students in either the first year or fifth year (senior) of training at the University of Vigo, Spain, who underwent training in artistic skills performed better than students who did not receive training. All students were evaluated on mental imaging ability with two standardized tests, the Visual Elaborate Scale (VES) (Slee, 1976) and the Vividness of Visual Imagery Test (VVIT) (Campos, 1998) and three drawing tests designed by art and mental imagery specialists that involved spatial representation, transformation of spatial relations, and memory. Based on results of analysis of differences between the two groups, the authors

concluded that “...training in artistic skills considerably enhanced mental imaging capacity” (Perez-Fabello & Campos, 2007, p. 231) and improved artistic skills in all of the measured areas.

### Predictors of Second Language Acquisition by Adult Learners

The amount of literature on second language learning is voluminous with varying and conflicting theories. While it is beyond the scope of this review to comprehensively address second language theory, it is acknowledged that adult second-language learning of ASL may be affected by factors espoused in second language learning theory. Some of these factors include: (a) degree of exposure to a rich cultural and linguistic environment in which to learn such as young children experience, (b) being past the prime time for language acquisition, (c) degree of motivation and self-directedness for learning the language, (d) degree of fear of failure, (e) length of the learning process to achieve second language competency, (f) attitude biases toward the people and culture, (g) possible fundamental differences in L1 and L2 acquisition processes, and (h) L1 competency prior to L2 learning (Bialystok & Hakuta, 1994; Clément, Dörnyei, & Noels, 1994; Gan, et al., 2004; Gao, 2001; Sawyer & Ranta, 2001; Sparks, Patton, Ganschow, & Humbach, 2009). In recent years some researchers have debated whether there may be a true foreign language learning disability (FLLD) that can affect second language learning (Krug, Shafer, Dardick, Magalis, & Parantè, 2002; Sparks, 2006).

Studies of ASL acquisition by adult learners are scarce (Rosen, 2004). Some studies have focused on internal constructs such as *motivation, anxiety, persistence, patience* and *curiosity* (Lang, Foster, Gustina, Mowl, & Liu, 1996; Shaw, Grbic, & Franklin, 2004; Stauffer & Shaw, 2006). Other studies on adult acquisition of ASL focused on specific

aspects of language learning such as articulation errors in production (*handshape, palm orientation, location in space, movement and non-manual facial markers*) (Rosen, 2004).

Some studies focused on difficulties in acquiring ASL syntax and grammar including linguistic components such as receptive fingerspelling or non-manual grammatical markers (McKee & McKee, 1992; Shipgood & Pring, 1995; Wilcox, 1992).

Fewer still are studies of characteristics or skills and abilities that may contribute to success in learning ASL or interpreting and may have potential in predicting aptitude for sign language acquisition (Bontempo, 2008; Macnamara, 2008; Rudser & Strong, 1986; Taub, et al., 2006b). Practically since sign language interpreting became professionalized in the U.S. during the mid 1960s, interpreters, ASL teachers, and researchers have considered what set of qualities and characteristics competent interpreters possess. In 1974, Barbara Babbini Brassel, a prominent deaf administrator, advocate and political leader, expressed what most knew intuitively, that interpreter competence is “a conglomerate of skills...some more important than others, and that these skills are partly technical, partly psychomotor, partly cognitive, partly attitudinal and partly experiential” (Babbini, 1974 as cited in Mowl, 1981, p. 7). Research has attempted to identify more specifically some of these skills and characteristics

#### *Personality Characteristics as Predictors of Success*

Early studies of possible predictors of ASL and/or interpreting proficiency focused primarily on personality characteristics. One of the earliest studies was conducted in the mid 1970s. Schein (1974) investigated personality characteristics as predictors of interpreter proficiency. Twenty interpreters completed a battery of psychological tests. Results indicated a significant correlation between interpreter skill and four characteristics: “...*desire*

*to be the center of attention and to be independent, is not overly anxious, does not seek sympathy for self, and is not rigid” (p. 42).*

Other studies have made use of the Myers-Briggs Type Indicator (MBTI) with interpreters or interpreting students. The MBTI has been used to assess personality characteristics that might contribute to success in interpreting, both spoken and signed. The MBTI is an instrument that identifies individuals across four preference pairs: Extraversion or Introversion, Sensing or Intuition, Thinking or Feeling, and Judgment or Perception. Reported results have been mixed. Blake (n.d.) reported that the predominant type for interpreters was INFP (16%), whereas the predominant type for interpreting students was ISFJ (26%). Schweda-Nicholson (2005) tested interpreter trainees with 50% of the students reported as Introverts and 50% reported as Extroverts. Seventy-five percent (75%) of the students reported as Sensing and 25% reported as Intuitive. Students reported Thinking over Feeling by almost 2:1. In the last category 56% of the students reported as Judging and 44% reported as Perceiving. The result is that the largest group of students reported as ISTJ. Wilcox (1981) tested a group of beginning sign language students. The group reported predominantly as Extroverts (53%), Sensing (53%), Feeling (75%) and Perceiving (57%), or ESFP. Although two studies tested interpreting students and one study tested sign language students, none of the groups reported the same personality profile (ISFJ, ISTJ, ESFP).

A study by Lang, Foster, Gustina, Mowl, and Liu (1996) investigated motivational and attitudinal orientations in learning ASL. In the study of 115 survey respondents who did not know sign language prior to their employment at a large postsecondary program for deaf students, high ASL proficiency was correlated with *integrative motivational orientation* (willingness to learn the language, social habits, and culture of the target community) and

*cultural attitude toward deafness*. Respondents with high *instrumental motivation* (using the target language for personal fulfillment or advancement) and a medical attitude towards deafness did not attain high levels of ASL proficiency. It was noted that high school students tend to display instrumental motivation related to grades, credit, and course completion, which did not appear as relevant to adult learners.

In 2001, Peterson investigated the perceptions of beginning ASL students. He reported that the students he interviewed had little knowledge about language acquisition, and they had misconceptions and erroneous expectations about ASL and course content. These students also expressed anxiety about using ASL with Deaf people.

A study by Shaw and Hughes (2006) addressed interpreting students' academic habits and skills, information processing abilities, and personality characteristics. Spoken language and sign language interpreting faculty and students in the United States, Canada, Austria, Great Britain, Czech Republic, Germany, Denmark, Italy, and France were surveyed for their perceptions regarding characteristics most important for success in interpreting courses. The premise of this study was that teachers and students of interpretation are in the best position to identify such characteristics. The study revealed that students and faculty agree on some items as "most important," but diverge in their thinking of the importance of other items. Academic habits and skills identified by both students and faculty as most important were *strong desire to learn, self-regulation learning, independent involvement with L2 users, and spoken L1 competency/ability to articulate thought*. For information processing skills, faculty and students agreed that *ability to distinguish figure-ground/critical message from context* is most important. For personality characteristics, students and faculty both reported



*self-motivated, flexible/willingness to change on short notice, and self-confident* as most important.

Stauffer and Shaw (2006) analyzed a portion of the data from the above study focusing on a comparison of ASL interpreting students with spoken language interpreting students regarding the importance of 17 personality characteristics. One personality characteristic was rated significantly different indicating a difference of perception by the two groups: *patient*, 89% of sign language interpreters rated it as *very important* while 36% of spoken language interpreters rated it as somewhat important or not important. Results indicated that three other characteristics, *curious, comfortable in groups, and accepting of instructor feedback* had moderately significant differences between the two groups of interpreting students. There were no significant differences between the two groups of interpreting students for 13 other characteristics: *self-motivated, persistent, goal-oriented, assertive, flexible (willing to change on short notice), outgoing, ambitious, self-confident, risk-oriented, self-reliant, resilient, fearless, and able to separate my ego from my performance*.

A study by Ivars and Calatayud (2001) reported no relation between fear of public speaking and interpreter performance; however, they recommend that students should attend to coping strategies such as *self-efficacy, responsibility, maturity, sense of challenge*, etc. By developing interpreting resources and coping strategies, interpreting students can increase self-confidence and lessen feelings of fear and anxiety that accompany interpreting in public or during testing.

### *Skill Predictors of Success*

Some studies of language learning investigated skill predictors of success rather than personality factors referred to by Timarová and Ungood-Thomas (2007) as “soft factors” (p. 42). In one study perceptual-motor skills and cognitive abilities are reported to be more important to predicting success than personality traits (Gómez, Molina, Benítez, & Santiago, 2007). Emmorey, et al. (1993) have reported that *processing motion, faces, and imagery as well as visual ability such as mental rotation* are important for understanding and producing signed languages.

Rudser and Strong (1986) analyzed data on 30 interpreters originally collected from Quigley, Brasel, and Montanelli in 1973. The goal of Rudser and Strong’s study was to identify cognitive, perceptual, psychomotor, and affective characteristics associated with sign language interpreting ability. Results indicated no significant correlation between interpreting accuracy and IQ, manual dexterity, memory, spatial aptitude, verbal fluency and other factors. The authors did suggest, based on study results, that receptive *fingerspelling* might be a predictor of interpreting ability and “...thus might provide a simple testing procedure that could be used for evaluating and screening interpreters, interpreter trainees, and students” (p. 324).

Taub, et al. (2006a) investigated whether *gestures used with speech (co-speech gestures)* could be a predictor for ASL aptitude. The researchers conducted a longitudinal study over eight months of 18 adult second language (L2) learners of ASL. Using pre- and post- assessments, students’ use of first person discourse and co-speech gestures, use of third person discourse and co-speech gestures, and use of location in co-speech gesture were assessed. Eight months later these students were measured on first person discourse, third

persona discourse, and location use. Their goal was to “...see if any individual’s skill in gesture could predict skill development in ASL after two semesters of ASL classes” (p. 645). The authors concluded that *preexisting ability to set up space with gestures* might offer some predictability for the development of some spatial skills in ASL and proposed that future study in this area might be productive in predicting aptitude for learning sign language.

The same year, Taub, et al. (2006b) investigated gesture and mental imagery in ASL learning. One question they wanted to investigate was whether co-speech gestures used by hearing signers could predict ability to learn sign language. Results indicated that beginning sign students entering interpreter education programs were “...significantly better at image generation than other subjects; this suggests that students self-selected based on the [mental imagery] MI skills” (p. 209).

In 1993 Talbot and Haude investigated the relationship between sign language skill and spatial visualization. The Mental Rotations Test was administered to 54 women ages 19 to 48 years who were divided into three groups based on self-report of ASL skill. The women who reported themselves more experienced in ASL also scored high on the Mental Rotations Test. The authors concluded that women who are experienced in ASL perform better on spatial tasks than women with less ASL experience. They noted that no determination could be made on whether learning ASL improves spatial ability or whether women with strong spatial ability are attracted to the field of interpreting. This study did not include men who are often reported to perform better than women on tasks of mental rotation without practice (Vandenburg & Kuse, 1978).

## Measures of Vividness and Control of Mental Imagery

There are two types of measures of mental imagery reported in the literature. These types include *general* that score attributes of memory such as vividness or controllability, and *specific* that focus on one attribute of imagery (Richardson, 1994). The most commonly used measure of visual imagery tends to be self-report questionnaires of vividness of imagery or control of imagery (Cooper, 2004)

### *Selected Measurement Instruments of Vividness of Imagery*

*Questionnaire on Mental Imagery (QMI)*. In 1909 Betts developed a 150-item questionnaire to measure vividness of imagery across seven modalities (visual, auditory, tactile, gustatory, kinesthetic, olfactory, and organic (Richardson, 1994).

*Short Betts QMI*. Sheehan (1967) revised and improved the QMI, reducing the number of items to 35. High correlations are reported between the long and short versions (Cooper, 2004; Richardson, 1994; Sheehan, 1967).

*Vividness of Visual Imagery Questionnaire (VVIQ)*. Marks (1972) created a 16-item questionnaire that builds on the QMI visual subscale. Subjects are asked to imagine four familiar scenes, first with their eyes open and then with their eyes closed, and rate their visual imagery on a five-point Likert scale. The VVIQ is the most widely reported measure of vividness of visual imagery with a reliability range reported between .67-.87 (Cooper, 2004) and a reported satisfactory level of internal consistency, adequate stability, and relative freedom from serious social desirability biases (Richardson, 1994). This test is also available in Spanish (Campos, Gonzales, & Amor, 2002).

*Vividness of Movement Imagery Questionnaire (VMIQ)*. (Isaac, Marks, & Russell, 1986). This is a 24-item measure using the same five-point scale as the VVIQ. Participants

visualize items first as though they were watching someone perform the action, then as if they were doing it themselves. Eyes remain closed for this assessment. This instrument has high convergent validity with the VVIQ (.81) (Isaac, et al., 1986 as reported in Cooper, 2004).

*Cooper Quality of Imagery Scale (CQIS).* For her dissertation, Cooper developed a scale to measure the quality of visual imagery of athletes for use in sports psychology, particularly to assess differences in athletes' ability to perform a range of sports-related imagery tasks such as mental rehearsal. Unlike other tests that are pencil and paper based, this instrument is computer based (Cooper, 2004).

#### *Selected Measurement Instruments of Control and Manipulation of Imagery*

*Controllability of Visual Imagery Questionnaire (CVIQ).* In 1949 Gordon developed a 12-item instrument. This tool was revised in 1969 by Richardson as the Test of Visual Imagery Control (TVIC). It uses a five-point scale to assess participants' ability to visualize and manipulate an automobile's position and movements. Reported test-retest reliability is .84 (Cooper, 2004).

*Controllability of Imagery Questionnaire (CIQ).* In 1977 Land constructed a 35-item scale in which a pair of events is imagined sequentially and rated according to ability to create the image and ability to change and mentally hold the image as suggested. Reported correlation with the short Betts' QMI is .7 ( $p < .01$ ) (Richardson, 1994).

#### *Selected Tests of Mental Rotation*

Tests of mental rotation were originated with Shepard and Metzler in 1971. The test was revised by Vandenberg and Kuse (1978) and became widely used in research studies. In 1995 Michael Peters and his colleagues updated the test now named the *Revised Vandenberg*

*& Kuse Mental Rotations Test.* This test offers four versions (forms MRT-A to MRT-D) and is based on the original Vandenberg figures that were, themselves, based on the original Shepard and Metzler figures.

In tests of mental rotation, test-takers are asked to compare one 3-D image or letter (presented as a 3-D object or as a 2-D image on paper) to two or more images with one that has been rotated a specific number of degrees or is a mirror image. Test-takers are checked for accuracy and speed in pairing the correct images. Research on these tests indicates that boys generally do better than girls for unpracticed tests (Geiser, Lehmann, & Eid, 2008; Collins & Kimura, 1997).

Studies of mental rotation with deaf ASL signers, hearing signers who have deaf parents, and hearing non-signers were conducted by Emmorey, et al. in 1993. Results indicated that deaf ASL signers and hearing signers of deaf parents scored similarly while hearing signers of deaf parents scored faster than hearing non-signers. The authors suggest that the ability to mentally rotate imaged patterns may be tied to experience with ASL rather than lack of auditory ability.

Similar results were reported in a study conducted by Emmorey, Klima, and Hickok (1998). In their study deaf participants were more accurate in responding to views of scenes from the signer's perspective that requires 180-degree rotation than from the viewer's perspective requiring no rotation. When asked to rotate scenes, deaf signers were significantly better at the task than hearing non-signers.

#### *Reliability of Self-Report Questionnaires*

Numerous reports cite limitations of self-report instruments. Some of these limitations include (a) the influence of perceived social desirability, that is, the tendency for

persons to want to “look good” and score accordingly; (b) challenges in measuring individual differences to the same stimulus (ex: what one person may consider “very vivid” may be considered by another person as “somewhat vivid”); (c) the accuracy of individuals’ subjective evaluation of their internal event; and (d) the influence of acquiescence, that is, it is often easier to say “yes” than “no” (Ashton & White, 1975; Di Vesta, Ingersoll, & Sunshine, 1971; Ernest, 1977; Kaufmann, 1981; Moran, 1993).

Given these limitations, it is reasonable to review the adequacy of imagery self-report questionnaires as test instruments. According to Kaufmann (1981) “several studies... seem to leave no doubt that imagery questionnaires have an acceptable reliability as determined by conventional procedures” (p. 60). He goes on to report, however, that these results may be deceptive due to the nature of imagery as an internal, private, and subjective event that is difficult to measure. Individuals may report self-evaluation of images differently. People are not trained to compare their imagery for color, vividness, etc. and, therefore, may have different conceptions of the rating scales within these questionnaires. Researchers cannot know how individuals differ in rating against an absolute scale of vividness measurement (ex: moderately clear and vivid, not clear but recognizable) (Richardson, 1994). Additionally, people may use different language (words) to describe their experiences. Other criticisms of self-report questionnaires include high convergent validity between measures of vividness and controllability indicating that these instruments may be measuring the same construct (Cooper, 2004). These findings create potentially serious threats to the reliability of self-report imagery questionnaires.

Despite these concerns, it must be noted that self-report questionnaires tend to be the most common measure of imagery vividness (Burton, 2003; Dean & Morris, 2003; Moran,

1993). The *Vividness of Visual Imagery Questionnaire (VVIQ)*, (Marks, 1972) is reported as one of the most frequently used imagery measures (Chara & Verplanck, 1986). A meta-analysis of more than 150 published studies with the VVIQ conducted by McKelvie (1995) demonstrated high reliability, content and criterion validity.

### Summary

ASL is a visual, spatial language requiring learners of the language to be able to create and manipulate mental representations. Although there is a plethora of studies of factors influencing visual imagery among hearing persons such as memory, emotion, age, gender, and training, there is a lack of scholarly work investigating the mental imagery abilities of sign language students. A few studies have investigated the skills and characteristics that may have some practical application for prediction of student aptitude. Studies on the visualization skills for ASL production that have been conducted usually compare the visual imagery abilities of deaf native ASL users to hearing signers of varying abilities or hearing non-signers.

There are a variety of instruments reported over the years to measure vividness and manipulation of mental imagery. Some of these are self-report questionnaires that may be influenced by other factors such as acquiescence, and so forth. Others are objective measures such as mental rotations tests.

This study seeks to determine if there is a significant difference in visualization skills among groups of students across language learning development within college and university interpreter education programs and skilled interpreters in order to further the knowledge of foundational skills necessary for learning ASL and interpreting.



### **CHAPTER THREE: METHODOLOGY**

The purpose of this study was to investigate the relationship among beginning ASL students, advanced ASL students, and credentialed interpreters on their visualization abilities. The hypothesis is that advanced ASL students score higher on measures of visual imagery vividness and imagery manipulation than beginning ASL students, and by extension, credentialed interpreters score higher on these same measures than advanced ASL students. Given the lack of published studies on the visualization skills of ASL students, this study contributes to a greater understanding of these students' visual abilities. Specifically this study targets the gap between the knowledge of ASL as a visual language and the lack of assessment of visual abilities of ASL students.

This chapter presents a comprehensive description of the research design and methodology used in this study. It describes the participant selection, instrumentation and procedures to be followed. It concludes with a description of the planned data analyses.

#### **Research Questions**

This study investigated the visualization skills across two domains -- vividness and ability to manipulate visual imagery-- in ASL students enrolled in university semester-long courses of beginning and advanced ASL and also credentialed interpreters. The following research questions were addressed:

1. What is the relationship between students' vividness and manipulation of visual imagery and status in university level ASL classes?
2. What is the relationship between credentialed interpreters' vividness and manipulation of visual imagery and that of beginning and advanced students of ASL?

3. What is the relationship between students' vividness and manipulation of visual imagery and ASL instructors' evaluation of sign communication proficiency?
4. Are students' measures of imagery and vividness predictive of instructors' rating of students' sign language competency?

### Research Hypotheses

There are several hypotheses underlying these research questions. They are:

1. Advanced ASL students score significantly higher than beginning ASL students on a measure of imagery vividness. The null hypothesis is that there is no difference between beginning and advanced students' scores on this measure.
2. Advanced ASL students score significantly higher than beginning ASL students on a measure of imagery manipulation. The null hypothesis is that there is no difference between beginning and advanced students' scores on this measure.
3. Credentialed interpreters score higher on measures of imagery vividness and imagery manipulation than both the beginning and advanced ASL students. The null hypothesis is that there is no difference among interpreters' scores and the beginning and advanced students' scores on these measures.
4. Students' scores on the measures of imagery vividness and manipulation correlate with their instructors' evaluation of sign communication proficiency as rated on the SCPI Rating Scale. The null hypothesis is that there is no correlation between students' visualizations scores and their instructors' rating of students' sign communication proficiency.
5. Students' measures of imagery and vividness are predictive of instructors' rating of students' sign language competency. The null hypothesis is that these measures

provide no predictive ability regarding instructors' rating of students' sign language competency.

### Research Design

ASL students were targeted at two levels of study: beginning ASL and advanced ASL study. A group of interpreters who are professionally credentialed, that is, hold RID recognized national certifications (RID certificates, NAD IV/V), an EIPA 3.0 or higher, an Arkansas or Oklahoma Quality Assurance Screening Test (QAST) level I-V, or state certificate (ex: Texas BEI level 1-5) were also targeted. If visualization ability is per se a foundational skill for learning a signed language, and fluency in ASL is a pre-requisite for interpreting competency, then obtaining visualization test scores from credentialed interpreters may further support visualization ability as an aptitude for learning a visual language.

All participants completed a request for demographic information, a 16-item self-report questionnaire to assess their vividness of mental imagery, and a 24-item test of mental rotations to assess their ability to manipulate mental images. These two instruments correspond to the two-dimensional definition used in this study: visualization is the ability to create and manipulate visual images while in a waking state. Additionally, ASL students completed a self-report measure of their sign language proficiency and their instructors also completed the same measure for each student.

### *Population and Sample*

*Population.* According to the AA - BA Partnership Work Team of the Rehabilitation Services Administration (RSA) National Consortium of Interpreter Education Centers (NCIEC), there are 144 identified university interpreter education programs that offer a

degree in interpretation (N. Wentz, personal communication, March 1, 2009). Eighteen (18) of these programs are located within the five-state region of Arkansas (1), Oklahoma (2), Texas (13), Louisiana (1), and Mississippi (1).

The National Interpreter Education Center (NIEC) reported the results of a national needs assessment survey conducted during 2006-2007 (Cokely & Winston, 2008). Ninety-one of the targeted 125 interpreter education programs responded to this comprehensive survey. Of the 91 respondents, 67 programs reported an ASL program component. The reported average class size for ASL classes was 18 students per class.

The Modern Language Association of America (MLA) reports regularly on language study across many languages and levels. MLA reported that in 2002 over 60,000 students were registered for ASL (Furman, Goldberg, & Lusin, 2007). In 2006, a total of 78,829 students were studying ASL at the undergraduate and graduate levels. Of those students, 72,694 were at the undergraduate introductory level, and 5,249 students were at the undergraduate advanced level equaling 77,943 undergraduate students and providing “a ratio of undergraduate introductory to advanced at 14:1” (Furman, Goldberg, & Lusin, 2007, p. 21).

MLA also reported that the South Central region (AR, LA, MS, OK, TX) accounted for 9.8 percent of all language course enrollments. It can reasonably be calculated then that 9.8% of all ASL undergraduate students in 2006 (9.8% of 77,943 undergraduate students) equaled 7,638 students in the five-state region.

Not all ASL classes are taught in colleges and universities within interpreter education programs. Although introductory level ASL classes may be taught at some colleges and universities without interpreter education programs, it is reasonable to assume

that upper level classes will be taught as a component of ASL studies or interpreter education programs. For these calculations it was assumed that all beginning and advanced ASL classes are taught within the 18 interpreter education programs in the five-state South Central region. If students are equally distributed among the 18 programs, then 7,638 students across 18 programs computes to 424 students per program. Using a ratio of 14:1, 30 advanced ASL students would be expected in each program with 394 introductory and lower level students. An average class size of 18 equates to approximately 1.5 advanced classes and 23 introductory and lower level classes (see Table 1).

Table 1

*ASL students in South Central Region*

Source	Total	9.8% South	by 18 programs	14:1 ratio	by 18 students
Modern Language Association, 2006	77,943 Undergraduate Students	7,638 students	424 students per program	30:394	1.5:23

Assuming that 18 programs will have at least one advanced ASL class (ASL III or higher) and multiple beginning ASL classes, then there is expected to be a total population of 324 advanced ASL students in the five-state region (18 students/class; 1 class per 18 programs = 324 students).

Credentialed interpreters were solicited for voluntary participation from those attending workshops offered by the researcher on visualization during the Arkansas Registry of Interpreters for the Deaf (ARID) biannual conference, data collection trips to Oklahoma City, and Ada, OK, and from certified interpreters who were instructors in classrooms where

student data were collected. When data were collected as part of a workshop offering, it should be noted that the data were collected before the teaching aspect of the workshop began.

*Sample.* In determining a sample size, researchers must attend to statistical power (i.e., the ability to detect an effect); significance level; standard deviation (variation in the response variable); and effect size. Generally the larger the sample size, the greater the ability to detect small differences; however, too large a sample size may detect differences that are statistically significant but not practically significant.

Restraints other than statistical requirements affect sample size choice including temporal, geographical and fiscal constraints. In this study, I proposed to sample 20% of the projected advanced ASL student population from the South Central region (20% of 324 is 64 students). In doing so, I collected data from advanced ASL classes at the University of Arkansas at Little Rock, Oklahoma State University-OKC, East Central University (Ada, OK), Tarrant County College in Fort Worth, Texas, and Delgado Community College in New Orleans, Louisiana for a total of five programs from four states of the five-state region. Data were not collected from Mississippi as no advanced ASL courses were offered the semester that the data were collected.

There were multiple beginning ASL classes in each program. For each advanced ASL class, a beginning class from the same program was selected from all the beginning ASL classes. The resulting goal for this study was to obtain data from 64 beginning ASL students and 64 advanced ASL students for a total sample size of 128 students.

An online researcher's toolkit program ([http://www.dssresearch.com/toolkit/sscalc/size\\_p2.asp](http://www.dssresearch.com/toolkit/sscalc/size_p2.asp)) was used to calculate a sample size for this project. The VVIQ uses a 1-5 scale

on 16 items providing a score range between 16-80. A mean value for group 1 (beginning ASL students) is predicted to be 50%, and a mean value for group 2 (advanced ASL students) is projected to be 65%. In this calculation of sample size, a mean of 2.31 and a standard deviation of .69 is used for both groups. This corresponds to a reported overall mean and standard deviation in a review of 38 studies utilizing the VVIQ by McKelvie (1995). An  $\alpha = .05$  (the probability of incorrectly rejecting the null hypothesis that there is no difference in the average values) with a Confidence Interval of 95% and a Beta Error Level of .20 will be used for this calculation. The calculated sample size is 133 participants for both samples, or 66 students for each group. Statistical power (1-Beta) is .80. A projected sample size of 128 students (64 beginning ASL students and 64 advanced ASL students) is consistent with the above calculations and reasonable for this study.

The projected sample of 128 total students was also administered the Mental Rotations Test-Version A (MRT-A). The MRT, depending on the version used, has total scores that range from 20 to 35. Three studies report the mean score for females as slightly below the midway mark. Men in these studies scored at or slightly above the midway mark. The MRT-A used in this study is a 24-item instrument with a score of one or zero for each item. The midway mark is 12.0. The majority of beginning ASL students is typically female; therefore, these students were predicted to score below 12.0. The advanced ASL students, who were also predominantly female, were predicted to score above 12.0, i.e., similar to men. Calculations using the online toolkit indicate that a sample size of 64 individuals in each of the ASL level classes is adequate; therefore, the sample size appears reasonable from both a statistical and a practical perspective.

A sample size of 64 or more credentialed interpreters living in Arkansas, Texas and Oklahoma was solicited for participation in this study. A target sample size of 64 interpreters was chosen to be comparable in size to the two target student samples.

#### *IRB Approval and Program Contact*

All applicable rules and regulations governing the treatment of human research participants were followed and IRB approval was obtained from both the University of Arkansas (See Appendix A) and the University of Arkansas at Little Rock (see Appendix B) prior to data collection. Upon approval, program coordinators were contacted at the six programs in the five-state region that offer beginning and advanced American Sign Language classes. Permission was sought to test students using the two instruments and one rating scale during one class period and for the instructors to rate their students' sign language competency level. Those students who volunteered to participate by signing the consent form completed the two visual imagery instruments and self-rated their sign language competence using the SCPI Rating Scale

Six programs were contacted. Six IEP directors were emailed and asked: (a) if they would be interested in participating in this study by allowing data collection in their ASL classes, (b) to ascertain which semester(s) ASL I classes are taught, and (c) to determine their highest level ASL course and which semester(s) this class is taught. All six programs responded enthusiastically: UALR (AR), Tulsa Community College (OK), Collin County Community College (TX), Tarrant County College, (TX), Hinds Community College (MS), and Delgado Community College (LA). Three programs offered their highest level of ASL classes in the Spring semester, one in the Fall semester, and one both Spring and Fall semester. All offer ASL I during both semesters with at least two programs offering ASL



during the summer. Additionally, two more interpreter education programs in Texas gave verbal consent to be included in this study if needed.

### *Instrumentation*

To conduct this study, students' visual abilities were measured across two domains: the vividness of visual imagery that students are asked to create, and measurement of these students' performance on a test of mental rotation. These two domains relate to the two-part definition of visualization adapted from Marks (1972) and McKim (1972) and adopted for use in this study, that is, visualization is the ability to create and manipulate mental images in the mind while in a waking state.

Further support for a dual measure of visualization ability comes from a study by Dean and Morris (2003). They investigated why "no relationship" is often reported between self-report measures of imagery and performance of spatial tests thought to require the use of imagery. These researchers suggested that combinations of self-report and spatial tests may be better predictors of imagery performance than vividness measures alone as imagery sometimes is theorized to be a collection of abilities such as image formation, maintenance and transformation (Emmorey et al., 1993; Hiscock, 1978).

There are two challenges in measuring visual imagery: (a) measurement of mental imagery seeks to measure an internal event, a task that is difficult at best, and (b) instruments tend to rely on self-report measures. Cooper (2004) reviewed a variety of imagery instruments and concluded that:

Unfortunately all of the imagery instruments previously reviewed have been criticized for their: lack of construct validity; susceptibility to response sets and social desirability; lack of divergent validity; absence of current norms for interpretation; inadequate scripts to prompt visual images; and poor standardization (p. 16).

Despite multiple limitations, self-report questionnaires are commonly used in the measurement of imaging differences as well as a variety of other internal events. A perusal of titles in EBSCO under a search of “self-report questionnaire” articles reflects that questionnaires are used to measure other internal constructs such as fear, depression, sexual pleasure, and so forth.

*Vividness of Visual Imagery Questionnaire.* The instrument used in this study to assess vividness of visual imagery was the *Vividness of Visual Imagery Questionnaire (VVIQ)*, developed in 1972 by David Marks (Marks, 1973) (see Appendix C). It is reported as one of the most frequently used imagery measures (Chara & Verplanck, 1986) and is available in English and Spanish (Campos, Gonzales, & Amor, 2002). According to Marks (1999):

The VVIQ is an assessment of the vividness of visual imagery. The purpose of the VVIQ is to assess visual imagery vividness under conditions which allow for the progressive development of scenes, situations or events as naturally as possible. The items are intended to evoke interest, meaning and affect conducive to the evocation of visual imagery. There are four sets of items giving a total of 16 items and participants rate the vividness of their images separately with eyes open and eyes closed (p. 571) (see Appendix A).

Reviews of validity and reliability of this instrument are mixed. Chara and Verplanck (1986) investigated the construct validity of the VVIQ. Analysis of the study data indicated a lack of support for the measure’s validity. A study of the VVIQ, the Betts’ QMI (Questionnaire upon Mental Imagery) and Gordon’s TVIC (Test of Visual Imagery Control) found that “The available imagery questionnaires confuse the dimensions of vividness and control, fail to apply coherent definitions of either attribute of imagery and are relatively insensitive to individual differences in imagery ability” (Kihlstrom, Glisky, Peterson, Harvey, & Rose, 1991, p. 133).

A more recent meta-analysis of more than 150 published studies with the VVIQ conducted by McKelvie in 1995, also reported by Marks (1999), demonstrated high reliability, content validity, and criterion validity. Test-retest reliability reported by Richardson (1994) across several studies ranged from .71 (three week interval) to .73 (seven weeks apart) to .86 (two week interval). According to Richardson (1994), “All tests can be improved, but overall the existing VVIQ appears to have a satisfactory level of internal consistency; adequate stability, at least over short time intervals; and relative freedom from serious social desirability biases” (p. 28).

The author has previously given me permission to use this questionnaire with ASL students (see Appendix D). Additionally, this instrument is widely published and available online and in print (Richardson, 1994).

*Revised Vandenberg & Kuse Mental Rotations Test (form MRT-A)*. The instrument used in this study to assess manipulation of visual imagery was the *Revised Vandenberg & Kuse Mental Rotations Test* (Peters, 1995). It contains redrawn pictures from the Vandenburg & Kuse Mental Rotations Test, which in turn was based on the original Shepard and Metzler (1978) test figures. This instrument was chosen because it relies on the most commonly reported test of mental rotation with more updated figures, and it is not commonly accessible. The developer, Michael Peters, gave permission for this test to be used in this research project (see Appendix E). According to conditions of use, this test may not be shared; however, a published sample from the Vandenberg Test of Mental Rotation is included as a representation of this instrument (see Appendix F).

The MRT-A consists of 24 items whereby the test taker is asked to look at five drawn cube-shaped figures in each item. The first figure on the left is the stimulus, or target, figure.

Test takers are asked to choose two of four drawn images that, when rotated, match the original stimulus figure. The other two figures cannot be matched to the target figure. Examples and three practice items are presented to the test takers. The test is timed (four minutes for the first half of the items, five minutes rest, and four minutes for the second half of the items) and scored. Points are given only if both correct matches are identified.

A review of validity and reliability of mental rotations tests produced some validity studies. Measurement of spatial abilities encompassed two broad types of studies: those focused on spatial solution strategies (mental rotation, spatial perception and spatial visualization) and those focused on differences between men and women (Geiser, Lehmann, & Eid, 2006; Linn & Peterson, 1985; Schultz, 1991). Linn and Petersen (1985) conducted a meta-analysis of tests of mental rotation, specifically focusing on differences in spatial ability between males and females. They concluded that the Vandenberg Test of Mental Rotations "...may identify a spatial ability independent of verbal ability and may be differentiated from spatial visualization" (p. 1484). Additionally for mental rotation, they reported that large homogeneous effect sizes exist for gender across different ages. Men out performed women with women taking more time to respond.

A study by Voyer, Butler, Cordero, Brake, Silversweig, Stern, and Imperato-McGinley (2006) was conducted to evaluate concurrent validity between a computerized mental rotations test constructed on the Shepherd and Metzger Mental Rotation test, the pencil and paper 1978 Vandenberg and Kuse MRT, and the Spatial Relations subtest of the Primary Mental Abilities battery (PMA-SR). Results indicated a high correlation between the computer test and the pencil and paper tests by which the authors concluded that the computerized version is a valid measure of mental rotation abilities.

*Sign Communication Proficiency Interview (SCPI) Rating Scale.* Students' sign language competency was measured by both the instructors' rating and the students' self-rating using the Sign Communication Proficiency Interview (SCPI) Rating Scale (Newell, Caccamise, Boardman, & Holcomb, 1983). This scale describes sign language competency on an eleven-item scale with level one (1) labeled "no functional skill" and level eleven (11) labeled as "superior plus," i.e., native-like skills (see Appendix E). The SCPI scale was adapted from the U.S. Foreign Service Institute and the American Council on the Teaching of Foreign Languages (ACTFL) Language Proficiency Interview Rating Scales that meet psychometric requirements of validity and reliability.

The SCPI (called the SCPI from 1983- May 2006) is a "...construct-referenced test that uses the SLIP rating scale, which is a standard scale based on a detailed and explicit language skills construct" (Caccamise & Samar, 2009, p. 36). Inter-rater reliability testing was conducted resulting in 87% of raters' first independent ratings being the same or within one rating level of the other two members of the 3-person rating team. Additionally the authors concluded that the data from their NTID study provided "clear evidence that the SLPI 3-rater team procedure results in reliable and valid official ratings" (p. 42).

Studies have further investigated the reliability of the SCPI. A study conducted by Long, G., Stinson, M., Kelly, R. and Liu, Y. (1999) assessed the relationship between deaf college student's ratings of their instructors' communication effectiveness and instructors' sign communication proficiency determined by their SCPI level. Results indicated a small but significant correlation between students' perception of communication ease with their instructors as rated on the Teacher-Focused Communication Ease Scale and the instructors' SCPI level.

Although the scale was designed for use by a trained rater team watching a recorded interview conducted by a trained, deaf interviewer, the scale provides sufficient language level descriptions for instructors and students to rate student competency. The SCPI Rating Scale is available online at various websites. For this study the scale was obtained from [www.ksd.k12.ky.us/Intrepreters%20Sign%20Lang/ SCPI%20description.htm](http://www.ksd.k12.ky.us/Intrepreters%20Sign%20Lang/SCPI%20description.htm).

This instrument was not used with interpreters as their national or state certification or state quality assurance level assures language proficiency that surpasses the SCPI ratings; therefore, credentialed interpreters have already demonstrated superior sign language communication skills.

#### *Procedure with Interpreters*

The VVIQ and the MRT-A were administered to 68 experienced, nationally certified or state credentialed interpreters recruited during the biannual conference of the Arkansas Registry of Interpreters for the Deaf (ARID), during workshops offered by the researcher and from certified interpreters who were instructors of ASL classes from which data were collected. The VVIQ, the MRT-A, and a demographics page were replicated into one “Interpreter” test booklet for test administration. All interpreters were given a consent form prior to the test administration along with a description of the study. Only interpreters who agreed to participate by signing and returning the consent form were given the test booklet and administered the VVIQ and the MRT-A.

The interpreters were given unlimited time for the VVIQ. The testing instructions direct the 16 items to be rated once with their eyes open and again with their eyes closed. For this study, interpreters were directed to rate the 16 items only once, with their eyes open or closed, that is, whichever way they were most comfortable.

Following the VVIQ, interpreters were given the MRT-A. Participants had a timed, four-minute span to complete the first 12 items. After a five-minute rest, they again had a timed, four-minute span to complete the second 12 items.

Each interpreter was assigned a unique number (1→total number of returned questionnaires). The interpreters also responded to the request for demographic information. These individuals did not complete the SCPI Rating Scale. By virtue of their credential, they have demonstrated sign language competency at a higher level.

Another purpose of this test with interpreters was to see if measures of imagery vividness and manipulation are high in experienced interpreters. If so, this finding will lend credence to the hypothesis that visualization is a critical skill present in ASL users with high skill level, and support the need to give attention to interpreting students' visualization abilities as they enter and progress through a language program. It will also provide a benchmark against which to compare the sign language students' visualization scores.

#### *Procedures with ASL Students*

The VVIQ, the MRT-A, a demographics page, and the SCPI Rating Scale were replicated into one "Student" test booklet for test administration. In all, 90 beginning ASL students and 64 advanced ASL students participated in the study. Administering all instruments required no more than 40 minutes total. All participating students were tested during a regular ASL class period. Prior to testing a copy of the UA IRB approval was given to the instructor.

Students read, signed and returned a consent form to the researcher prior to being given the test booklet. The consent forms and test booklets contained matching identification numbers. Each student was assigned a unique number consisting of an institutional number:

(1 → 5 number of institutions participating), class status number (1=beginning ASL class, 3 or 4=advanced ASL class), and numerical number (1→total number of returned questionnaires in each class).

The test instructions direct participants to rate the 16 items of the VVIQ once with their eyes open and again with their eyes closed. For this study, all students were directed to rate the 16 items only once, with their eyes open or closed, that is, whichever way they were most comfortable.

Following the VVIQ, interpreters were given the MRT-A. Participants had a timed, four-minute span to complete the first 12 items. After a five-minute rest, they again had a timed, four-minute span to complete the second 12 items.

Identifying information was collected only for the purpose of matching student self-rating score of sign language competency with instructor's score using the same scale. Student and instructor scores were matched for data entry; however, all analyses were conducted using non-identifying number coding and all analyses were conducted aggregately with no ability to identify individual participants or instructors.

The consent forms, with student signatures and corresponding unique identification numbers, were given to the instructor who rated each student's sign language competency adding the student number to the corresponding SCPI Rating Scale document. The unique participant number corresponded to the number on the test booklet. In this way (a) the instructor rated each student, (b) instructor competency ratings could be matched accurately but anonymously with each student's test response booklet, and (c) all demographic information and test scores could be entered anonymously. Signed consent forms and test booklets are kept by the researcher in separate, secured locations.



Descriptive demographic data such as participants' age, gender, ethnicity, class status (beginning or advanced ASL), and number of years of prior experience with ASL were collected. Directions were standardized for all data collection. The researcher administered all tests in a group setting. Both tests were conducted at one sitting with a 5-minute break between administering the two test instruments. All test booklets and consent forms were returned to this researcher. A thank you note was sent to each program coordinator and instructor.

## Data Analyses

### *Demographic Data Analyses*

Analysis of demographic variables was conducted to determine if there is a significant difference on one or more characteristics that might impact the results of the visualization test scores. A Chi-Square test of independence is used for categorical data to determine if there is a significant relationship between an independent variable and a dependent variable, A Chi-Square Test of Independence was used to analyze gender, ethnicity, and parental hearing status.

The remaining demographic data were analyzed using t-tests or an analysis of variance (ANOVA). ANOVA is an appropriate analysis is to test differences in means for statistical significance between two or more groups. Analyses identified any significant relationships between the five remaining dependent variables (age, numbers of years prior experience with ASL, number of years prior professional experience with person who are deaf and use ASL, instructor competency rating and student competency self-rating) and the independent variables, class status (ASL I class, advanced ASL class, and interpreter). Results of analysis are reported in Chapter 4.

Data on sign language competency were not collected on the interpreters as their national or state certification or state quality assurance level indicates ASL competency that surpasses the SCPI ratings; therefore credentialed interpreters have already demonstrated superior skills in ASL.

### *Instrumental Data Analyses*

Each beginning ASL class was evaluated to determine if there were any significant differences in students' self-ratings of sign language competency and the instructors' ratings of these same students' sign language competency. For beginning ASL classes the mean and standard deviations for both students' self-ratings of competency and instructors' rating of student competency are reported in Chapter 4.

Correlations between the students' self-evaluation of their sign language competency and the instructors' evaluation of students' sign language competency were analyzed using the Pearson product-moment correlation coefficient. "The Pearson correlation coefficient is appropriate when both variables being analyzed are assessed on an interval or ratio level, and the relationship between the two variables is linear" (Hatcher, 2003, p. 290). For this analysis, the variables, instructor rating and student self-rating, meet these criteria.

Correlation strength was interpreted as: .00 = no correlation,  $\pm .20$  = weak correlation,  $\pm .50$  = moderate correlation,  $\pm .80$  = strong correlation, and  $\pm 1.00$  = perfect correlation (Hatcher, 2003). Results of this analysis are reported in Chapter 4.

### *Summary*

The purpose of this study was to investigate the relationship between beginning ASL students' visualization abilities and their continued success in subsequent ASL classes. The hypotheses are that advanced ASL students score higher on measures of visual imagery

vividness and imagery manipulation than beginning ASL students and that credentialed interpreters score higher than advanced ASL students on these measures. The null hypotheses are that there is no differences between beginning ASL students, advanced ASL students, and credentialed interpreters on these two measures of visualization ability.

IRB approval was obtained and the two instruments were administered to a group of credentialed interpreters (RID certified, or recognized as certified; state certified, or state Quality Assurance Screening Test--QAST) recruited from the Arkansas Registry of Interpreters for the Deaf (ARID) biennial conference and from two free workshops given in Oklahoma as well as certified interpreters who were instructors of the classes in which data were gathered in Arkansas, Oklahoma and Texas. One purpose of the study is to provide a benchmark against which to compare the sign language students' visualization scores.

In addition to IRB approval, program approval was obtained before student data were collected. Students enrolled in interpreter education programs within the South Central region of the United States (AR, OK, LA, MS, TX) offering beginning ASL and advanced ASL were targeted. Based on estimates of student population in these classes, it was anticipated that 64 advanced ASL students would be tested. An equal number of beginning ASL students, randomly selected by class, were also targeted.

Data were collected from 68 interpreters, 90 beginning (ASL 1) students and 66 advanced (ASL 3 and ASL 4) students, slightly exceeding the projected numbers of 64 individuals in each of the three categories. Interpreters were administered both visualization instruments with data collected over a period from May to November 2009. The researcher administered all tests and followed standardized test procedures for each instrument. All interpreters signed a consent form prior to testing.

Student data were collected over a six-week period during the Fall 2009 semester. All student data were collected during regularly scheduled ASL classes. All students who participated signed a consent form describing the nature of the research project and indicating that they were voluntarily participating in the study.

Students were administered the *Vividness of Visual Imagery (VVIQ)* self-report questionnaire and the *Mental Rotations Test, Version A (MRT-A)*. The researcher administered all tests and followed standardized test procedures for each instrument. Students and instructors completed a rating of sign language competency using the *Sign Communication Proficiency Interview (SCPI) Rating Scales*. These scales describe competency on an 11-item Likert scale from “no functional skill” to “superior.”

A Chi-Square Test of Independence and a multivariate analysis of variance (MANOVA) was used for demographic data to determine if there were any significant differences between the three groups. A MANOVA was used for data analyses to determine if there were any significant differences between the scores of the beginning ASL students, the advanced students, and the interpreters on two tests of visualization ability. A correlation analysis was conducted to see if there is any significant correlation between the students' self-report ratings of sign communication proficiency and their instructors' rating on the same scale. Additionally a regression analysis was performed to determine the extent to which visual vividness and mental manipulation are associated with instructors' scores of students' sign communication proficiency. All results are reported in Chapter Four.

## CHAPTER FOUR: RESULTS

This chapter reports the results of this study investigating the relationship among beginning and advanced students of American Sign Language and credentialed interpreters on their visualization abilities, specifically across the two domains of visual vividness and control. Demographic information on participants is presented. A description of the participants overall performance on the VVIQ and the MRT is reported. Additionally, the relationship between students' self-report scores of sign language ability and their instructors' scores of language ability as rated on the SCPI scale is presented. Lastly results are reported on the students' measures on imagery and vividness as predictive of instructors' rating of students' sign language competency.

### Demographic Data Analyses

The demographic data are reported using descriptive statistics. The number of beginning students, advanced students, and interpreters, participants by status (beginning ASL, advanced ASL, interpreter), gender, age, ethnicity, parent(s)' hearing status, number of years of prior experience with ASL, and number of years of prior professional experience with persons who are deaf and use ASL are reported in Tables 2-9. Additionally instructors rated students' sign competency level and students' self-rated their own sign competency level. These scores were collected in the ASL classes as a way to validate ASL students' competency in addition to differentiating class level placement (see Tables 10-12).

Table 2

*Description of Participants by Gender, Ethnicity, and Parental Hearing Status*

Demographic Variables	Beginning ASL Students		Advanced ASL Students		Interpreters	
	N	%	N	%	N	%
Number of Participants	90		66		68	
Gender						
Male	17	19%	13	20%	09	13%
Female	73	81%	52	80%	59	87%
Ethnicity						
Caucasian	75	84%	51	77%	63	93%
Black/African American	10	11%	08	12%	03	04%
Hispanic/Latino/Latina	00	00%	03	05%	01	1.5%
Asian/Pacific Is./Hawaiian	01	01%	02	03%	01	1.5%
Native American	03	03%	02	03%	00	00%
Parent(s)' Hearing Status						
Mother Hearing	90	100%	63	95%	61	90%
Mother Deaf	00	00%	02	03%	07	10%
Father Hearing	87	99%	63	97%	61	90%
Father Deaf	01	01%	02	03%	07	10%

*Note: One participant did not indicate gender, ethnicity, or mother's hearing status  
Three participants did not respond to father's hearing status*

Analyses of demographic variables were conducted to determine if there was a significant difference on one or more characteristics that might impact the results of the visualization test scores. A Chi-Square test of independence was used for categorical data to determine if there was a significant relationship between the independent and dependent variables. A Chi-Square test was used to analyze gender, ethnicity, and parental hearing status (see Figures 1-3). Results are reported in Table 3.

		<b>Group</b>		
		Beginning ASL	Advanced ASL	Credentialed Interpreter
<b>Gender</b>	Male	N=17	N=13	N=09
	Female	N=73	N=52	N=59

*Figure 1. Status of students/interpreters by gender.*

		<b>Group</b>		
		Beginning ASL	Advanced ASL	Credentialed Interpreter
<b>Ethnicity</b>	Caucasian	N=75	N=51	N=63
	Black/African American	N=10	N=08	N=03
	Hispanic/Latino/Latina	N=00	N=03	N=01
	Asian/Pacific Islander	N=01	N=02	N=01
	Native American	N=03	N=02	N=00

*Figure 2. Status of students/interpreters by ethnicity.*

		<b>Group</b>		
		Beginning ASL	Advanced ASL	Credentialed Interpreter
<b>Parental Hearing Status</b>	Mother Hearing	N=90	N=63	N=61
	Mother Deaf	N=00	N=02	N=07
	Father Hearing	N=87	N=63	N=61
	Father Deaf	N=01	N=02	N=07

*Figure 3. Status of students/interpreters by parental hearing status.*

Table 3:

*Obtained Chi-Square Values for Each of Demographic Characteristics*

<i>Characteristic</i>	<i>N</i>	<i>Chi-Square Value</i>	<i>Probability</i>	<i>Cramer's V</i>	<i>Phi Coeff</i>
<b>Gender</b>					
Begin by Adv by Interp	223	1.2589	0.5329	0.0751	
Begin by Adv	155	0.1299	0.8628		-0.0139
Begin by Interp	158	0.9006	0.3426		-0.0755
Adv by Interp	133	0.2939	0.2939		-0.0910
Students by Interp	223	1.2266	0.2681		-0.0742
<b>Ethnicity (White, Other)</b>					
Begin by Adv	155	1.2199	0.2694		-0.0139
Begin by Interp	157	2.5432	0.1108		0.1273
Adv by Interp	134	6.2347	0.0125*		0.2157
<b>Parental Hearing (Student, Interp) Status</b>					
Mother	223	9.8933	0.0017**		0.2106
Father	221	7.5674	0.0059**		0.1850

\* p &lt;.05

\*\* p &lt;.01

*Note: One participant did not indicate gender, ethnicity, or mother's hearing status  
Three participants did not respond to father's hearing status*

*Gender*

A Chi-Square analysis did not result in a significant difference by gender among the beginning ASL students, advanced ASL students and the interpreters. Analysis was also conducted between each group. No significant difference was found between the beginning ASL students and the advanced ASL students, between the beginning ASL students and the interpreters or between the advanced ASL students and the interpreters. There was no significant difference between the students as a whole (beginning and advanced) and the interpreters. Both student groups and the interpreters were predominantly female. These



characteristics are similar to results reported in other studies of interpreter characteristics (Jones, 1993; Jones, 1997; Stauffer, Birch, & Boone, 1999).

### *Ethnicity*

There were too few members in each minority group to adequately run a Chi Square test of significance by individual groups. For that reason, all minority groups (Black, Hispanic, Asian, and Native American) were categorized as "Other." There was a significant relationship with the characteristic ethnicity between advanced ASL students and interpreters  $\chi^2(1, N = 155) = 6.2347, p < .05$ . The advanced ASL student group was characterized by significantly more minority students than the interpreters. There was no significant relationship with the characteristic ethnicity between beginning and advanced ASL students or between beginning ASL students and interpreters.

### *Parental Hearing Status*

Results indicate a significant relationship with the characteristic parental hearing status,  $\chi^2(1, N = 223) = 9.8933, p < .01$  (mother), and  $\chi^2(1, N = 221) = 7.5674, p < .01$  (father). In the sample, credentialed interpreters had a significantly higher number of parents (both mother and father) who are deaf than the ASL students.

*Cramer's V* is one measure to determine effect size used with Chi Square analyses. The table for gender is 2 X 3; therefore, *Cramer's V* is appropriate for the current analysis. For Chi-Square tables 2 X 2, the *Phi Coefficient* is appropriate for analysis of effect size. The effect sizes were .075 for gender, .216 for ethnicity, and .211 and .185 for parental hearing status. All are considered low or near low effect size (*Cramer's V* < .20).

The demographic data regarding age, years of prior experience using ASL, and years of prior experience with deaf professionals who use ASL were analyzed using an analysis of

variance (ANOVA). ANOVA is an appropriate analysis to test differences in means for statistical significance between two or more groups. Analyses identified any significant relationships between the remaining dependent variables (age, numbers of years of prior experience with ASL, and number of years of prior professional experience with persons who are deaf and use ASL) and the independent variable, class status (beginning ASL class, advanced ASL class, and credentialed interpreter) (See Figure 4). Data on sign language competency were not collected on the interpreters as their credentials indicate sign language competency at levels above the SCPI Scale.

Dependent (Criterion) Variables			
Independent Variable (Predictor)		Age	Number of Years Prior Experience with ASL
	Beginning ASL students		
	Advanced ASL Students		
	Interpreters		

Figure 4. Model showing the relationship among variables.

#### Age

Results of a one-way ANOVA indicated a significant difference in age between advanced ASL students and interpreters  $F(2,221) = 31.97, p < .0001, R^2 = .224$ . Post hoc analysis using Tukey's HSD criterion indicated that age was not significantly different between beginning ASL students ( $M = 26.76, SD = 10.29$ ) and advanced ASL students ( $M = 20.36, SD = 11.03$ ). Age was, however, significantly different between beginning ASL

students ( $M = 26.76$ ,  $SD = 10.29$ ) and interpreters ( $M = 40.51$ ,  $SD = 12.09$ ) and also between advanced ASL students ( $M = 20.36$ ,  $SD = 11.03$ ) and interpreters ( $M = 40.51$ ,  $SD = 12.09$ ). Interpreters, as a group, were older than the students, but there was no significant difference found between the two groups of students (see Tables 4 and 5).

Table 4

*Mean and Standard Deviation for Age*

Level	N	Mean	Std. Dev
Begin ASL	90	26.76	10.29
Adv ASL	66	29.36	11.03
Interpreters	68	40.52	12.09

Table 5

*ANOVA Summary Table for the Relationship between Class Status and Age*

Source	df	SS	MS	F	R <sup>2</sup>
Class Status	2	7844.08	3922.04	31.97*	.22
Within Groups	221	27110.88	122.67		
Total	223	34954.96			

Note:  $N = 224$

\*  $p < .0001$

*Years of Prior ASL Experience*

With respect to years of prior ASL experience, all combinations of level comparison were significant  $F(2, 221) = 15.88$ ,  $p < .0001$ ,  $R^2 = .13$ . This indicated that there were

significant differences in prior years of experience between beginning ASL students, advanced ASL students, and credentialed interpreters (see Tables 6 and 7). Post hoc analysis using Tukey's HSD criterion indicated that class status of beginning ASL students ( $M = 1.89$ ,  $SD = 10.58$ ), advanced ASL students ( $M = 9.35$ ,  $SD = 23.97$ ), and interpreters ( $M = 16.91$ ,  $SD = 14.49$ ) did significantly impact the number of years of prior ASL experience. This supports the proposition that the beginning students are, indeed, less experienced in ASL than the advanced students and the credentialed interpreters, and the advanced students are more experienced than the beginning ASL students but less experienced than the credentialed interpreters.

Table 6

*Mean and Standard Deviation for Number of Years Prior Experience with ASL*

Level	N	Mean	Std. Dev
Begin ASL	90	1.89	10.58
Adv ASL	66	9.35	23.97
Interpreters	68	16.94	14.49

Table 7

*ANOVA Summary Table for the Relationship between Class Status and Number of Years Prior Experience with ASL*

Source	df	SS	MS	F	R <sup>2</sup>
Class Status	2	8820.90	4410.45	15.88*	0.04
Within Groups	221	61379.64	277.74		
Total	223	70200.53			

Note: N = 224

\*  $p < .0001$

*Years Prior Experience with Deaf Persons who Use ASL*

A significant difference was apparent between beginning ASL students and credentialed interpreters regarding number of years of prior experience with deaf professionals who use ASL  $F(2, 221) = 4.18$ ,  $p = 0.0165$ ,  $R^2 = .04$ . Post hoc analysis using Tukey's HSD criterion indicated no significant differences between beginning students ( $M = 3.63$ ,  $SD = 17.87$ ) and advanced students ( $M = 9.14$ ,  $SD = 24.88$ ), or advanced students and interpreters ( $M = 12.63$ ,  $SD = 12.65$ ) (see Tables 8 and 9). This supports the proposition that beginning students as a group have had less exposure to deaf adults who use ASL than the advanced students and credentialed interpreters. It is interesting to note that there was no significant difference between the advanced ASL students and credentialed interpreters in their prior experience with deaf adults who use ASL.

Table 8

*Mean and Standard Deviation for Number of Years Prior Experience with Deaf Adults Using ASL*

Level	N	Mean	Std. Dev
Begin ASL	90	3.63	17.87
Adv ASL	66	9.14	26.88
Interpreters	68	12.63	12.65

Table 9

*ANOVA Summary Table for the Relationship between Class Status and Number of Years Prior Experience with Deaf Persons Using ASL*

Source	df	SS	MS	F	R <sup>2</sup>
Class Status	2	3260.48	1630.24	4.18*	0.02
Within Groups	221	86136.48	389.76		
Total	223	89396.96			

Note: N = 224

\*  $p < .05$

*Class Status and Students' Self-Rating of Competency on the SCPI Scale*

Students were evaluated to determine if there was a significant difference between beginning ASL students' SCPI scores and Advanced ASL students' SCPI scores. A *t*-test was conducted on the two groups of students' SCPI scores (see Table 10). A significant difference was reported between the two groups of students  $t(154) = 10.81, p < .0001$ . The advanced ASL students rated themselves significantly higher than the beginning ASL

students. Results support the proposition that the advanced ASL students have higher language competency skills than the beginning ASL students. Effect size was relatively large, calculated as  $d=(5.88-3.03)/(2.15)=1.33$ .

Table 10

*Mean, Standard Deviation, and Confidence Intervals for Students' Status and Self-Rating of Language Competency on the SCPI Scale*

Level	N	Mean	Std. Dev	CI	df	t value	p
Begin ASL	90	3.03	1.56	2.71, 1.36	154	10.81	<.0001
Adv ASL	66	5.88	1.71	5.46, 1.46			
All Students	156	4.24	2.15	3.90, 1.93			

*Class Status and Instructors' Competency Rating on the SCPI Scale*

Instructors also rated students' language competency on the SCPI scale. A *t*-test was conducted on the instructors' SCPI scores for the two groups of students (see Table 11). A significant difference was reported between the two groups of students  $t(154) = 8.13$ ,  $p<.0001$ . The instructors rated the advanced ASL students' language competency significantly higher than the beginning ASL students' language competency. These results are similar to the differences in the students' self-reported SCPI scores and further support the proposition that the advanced ASL students have higher language competency skills than the beginning ASL students. . Effect size was relatively large, calculated as  $d=(5.98-3.50)/(2.25)=1.10$ .

Table 11

*Mean, Standard Deviation, and Confidence Intervals for Students' Status and Teachers' Ratings of Language Competency on the SCPI Scale*

Level	N	Mean	Std. Dev	CI	df	t value	p
Begin ASL	90	3.50	1.81	3.12, 1.58	154	8.13	<.0001
Adv ASL	66	5.98	1.99	5.50, 1.70			
All Teacher	156	4.55	2.25	4.20, 2.02			

*Relationship Between ASL Students' Self-Rating and Instructors' Rating of Students' Language Competency on the SCPI Scale*

Each beginning and advanced ASL class was evaluated to determine if there were any significant differences in student's self-ratings of sign language competency and their instructors' rating of their sign language competency. For ASL classes the mean and standard deviation for both students' self-ratings of competency and instructors' rating of student competency are reported (see Table 12).

Correlation between the students' self-evaluation of their sign language competency and the instructors' evaluation of students' sign language competency was analyzed using the Pearson product-moment correlation co-efficient. "The Pearson correlation coefficient is appropriate when both variables being analyzed are assessed on an interval or ratio level, and the relationship between the two variables is linear" (Hatcher, 2003, p. 290). For this analysis, the variables, instructor rating and student self-rating, meet these criteria.

Correlation strength is interpreted as: .00 = no correlation,  $\pm .20$  = weak correlation,  $\pm .50$  = moderate correlation,  $\pm .80$  = strong correlation, and  $\pm 1.00$  = perfect correlation (Hatcher,



2003). The correlation between student self-rating and instructor rating of students' sign language competency is reported in Table 12.

Table 12

*Mean, Standard Deviation, and Correlation Between Students' Self-Ratings and Instructors' Ratings for All ASL students*

	Students N	Student		Instructor		Correlation
		Mean	SD	Mean	SD	
Beginning	N=90	3.03	1.56	3.50	1.81	0.44**
Advanced	N=66	5.88	1.71	5.99	1.99	0.37*
All students	N=156	4.24	2.15	4.55	2.25	0.62**

\* correlation is significant at the  $p < .01$  level

\*\* correlation is significant at the  $p < .0001$  level

Results indicate a moderate and significant correlation between beginning ASL students and their instructors on the SCPI rating scale, and a weaker yet significant correlation between the advanced students and their instructors on the SCPI rating scale. A moderately strong correlation was reported between the ASL students as a whole and their instructors indicating ASL students and their instructors rated similarly the students' language communication competency skills.

#### Test Data Analyses

Students' and interpreters' VVIQ and MRT-A scores were calculated. The VVIQ is rated on a scale with a low of 1 = *perfectly clear and as vivid as normal vision* to a high of 5 = *no image at all, you only "know" that you are thinking of an object* on each of 16 items. The MRT-A is scored on a scale ranging from 0 to 24, one point for each item correctly

identified. The final visualization scores are the dependent variables, and class status (beginning ASL, advanced ASL, or interpreter) is the independent variable (see Figure 5).

Independent Variable	Dependent Variables	
	VVIQ	MRT-A
	Beginning ASL students	
	Advanced ASL Students	
	Credentialed Interpreters	

*Figure 5.* Model showing the relationship between dependent and independent variables.

The data from administering the two visualization tests were analyzed using a multivariate analysis of variance (MANOVA), an appropriate statistical analysis with the presence of two or more dependent variables. Analysis identified any significant differences on the two dependent variables (VVIQ and MRT-A) by the independent variable, class status (beginning ASL class, advanced ASL class, and credentialed interpreters).

Results of analyses of the visualization data using MANOVA are reported for the scores from the beginning ASL students, the advanced ASL students, and credentialed interpreters. Analyses included whether one or more of the null hypotheses can be rejected, that is, there is a statistically significant difference between the beginning ASL students, the advanced ASL students, and the interpreters on one or both of these two instruments. Conversely, analyses also included whether the data failed to reject one or both of the null hypotheses that there is no statistical significance among the three groups on these two measures of visualization.

### *Vividness of Visual Imagery Questionnaire (VVIQ)*

Prior to analyses, the VVIQ scores were reversed so that the highest visualization rating *perfectly clear and as vivid as normal vision* was now scored a “5”, and the lowest visualization rating *no image at all, you only "know" that you are thinking of an object* was now scored a “1”. In this way, both scores were represented on a low-to-high score, meaning the higher the score the more visual the person is assumed to be. Table 13 presents the mean, standard deviation, the probability and effect size to determine statistical differences between the beginning ASL students, the advanced ASL students, and the interpreters on the VVIQ.

Table 13

*Means, Standard Deviation, Probability and Effect Size for the VVIQ with Beginning ASL Students, Advanced ASL Students, and Interpreters*

Group	N=	Mean	SD	P-value	R <sup>2</sup>	F <sub>(linear)</sub>	Sig.
Begin ASL Students	90	63.64	13.88	0.52	.006	1.30	.26
Adv ASL Students	66	64.62	12.99				
Interpreters	68	66.00	11.08				

Results indicated that there was no significant relationship between the three levels of participants on the VVIQ scores; therefore, the null hypothesis could not be rejected. The VVIQ failed to distinguish among the beginning ASL students, the advanced ASL students, and the credentialed interpreters. The effect size was less than 1%. There was, however, suggestive evidence that that VVIQ mean scores did increase as the students advanced, even if the increase did not rise to the level of significance. A polynomial trend analysis resulted in a p-value of .256, much better than the prior p-value of .52, but still not approaching any level of significant difference.

The data were analyzed a second time using an analysis of variance (ANOVA) comparing only the 20 nationally certified interpreters with the 90 beginning ASL students  $F(1, 108) = 4.87, p = 0.03, R^2 = .04$  (See Tables 14 and 15). Post hoc analysis using Tukey's HSD criterion indicated that the VVIQ scores were significantly different between the beginning ASL students ( $M = 63.64, SD = 13.88$ ) and the credentialed interpreters ( $M = 70.75, SD = 7.83$ ) with credentialed interpreters scoring significantly higher levels of visual vividness than the beginning ASL students. Although the difference was significant, it accounted for less than 1% of the variance between the two groups.

Table 14

*Mean and Standard Deviation of Beginning ASL Students and Nationally Certified Interpreters on the VVIQ*

Level	N	Mean	Std. Dev
Beginning ASL	90	63.64	13.88
Nationally Certified Interpreters	20	70.75	7.83

Table 15

*ANOVA Summary Table for the Relationship between Class Status and VVIQ*

Source	df	SS	MS	F	R <sup>2</sup>
Class Status	1	826.182	826.1823	4.87*	.04
Within Groups	108	18318.3722	169.6146		
Total	109	19144.5546			

Note: N= 110

\*  $p < .05$

*Mental Rotations Test – Version A (MRT-A)*

Table 16 presents the mean, standard deviation, probability and effect size to determine statistical differences among the beginning ASL students, the advanced ASL students, and the interpreters on the MRT-A.

Table 16

*Means, Standard Deviation, Probability and Effect Size for the MRT-A with Beginning ASL Students, Advanced ASL Students and Interpreters*

Group	N=	Mean	SD	P-value	R <sup>2</sup>	F <sub>(linear)</sub>	Sig.
Begin ASL Students	90	11.32	4.75	0.47	.007	1.25	.27
Adv ASL Students	66	11.23	6.38				
Interpreters	68	10.32	5.15				

p < .05

As with the VVIQ, there were no reported significant differences among the three groups regarding their score on the MRT-A. Again, the null hypothesis could not be rejected for this variable. In this analysis the mean decreased slightly from beginning ASL student to advanced ASL students to credentialed interpreters. A polynomial trend analysis increased the significance level from .471 to .265, but again, did not approach a level of significance between the three groups.

This data were also analyzed a second time using an analysis of variance (ANOVA) comparing only the 20 nationally certified interpreters with the 90 beginning ASL students  $F(1, 108) = 0.00$ ,  $p = 0.98$ ,  $R^2 = .00$  (See Tables 17 and 18). Post hoc analysis using Tukey's HSD criterion indicated that the MRT scores were not significantly different between the beginning ASL students ( $M = 11.32$ ,  $SD = 4.74$ ) and the credentialed interpreters ( $M =$

11.35, SD = 4.11) indicating no difference between interpreters and beginning ASL students on scores of mental rotation.

Table 17

*Mean and Standard Deviation of Beginning ASL Students and Nationally Certified Interpreters on the MRT-A*

Level	N	Mean	Std. Dev
Beginning ASL	90	11.32	4.74
Nationally Certified Interpreters	20	11.35	4.12

Table 18

*ANOVA Summary Table for the Relationship between Class Status and VVIQ*

Source	df	SS	MS	F	R <sup>2</sup>
Class Status	1	0.0126	826.1823	40.00	0.0
Within Groups	108	2324.2056	21.5204		
Total	109	2324.2182			

Note: N= 110

*Instructors' SCPI Scores Correlated with VVIQ and MRT-A*

One of the research questions inquired about the relationship between students' vividness and manipulation of visual imagery and ASL instructors' evaluation of sign communication proficiency. A correlation analysis was conducted to determine if there was a relationship between the instructor SCPI ratings and the VVIQ scores and the MRT-A

scores for beginning ASL students and advanced ASL students (see Tables 19 and 20). A correlation is an appropriate analysis to evaluate the relationship between two variables.

Table 19

*Correlation Between Instructors' Ratings of Beginning Students' Sign Communication Proficiency and Scores on the VVIQ and MRT-A*

Variables	Instructors Rating	VVIQ	MRT-A
Instructors Rating	1.00	-0.01971	-.010814
VVIQ	-0.01971	1.00	-0.10075
MRT-A	-.010814	-0.10075	1.00

Table 20

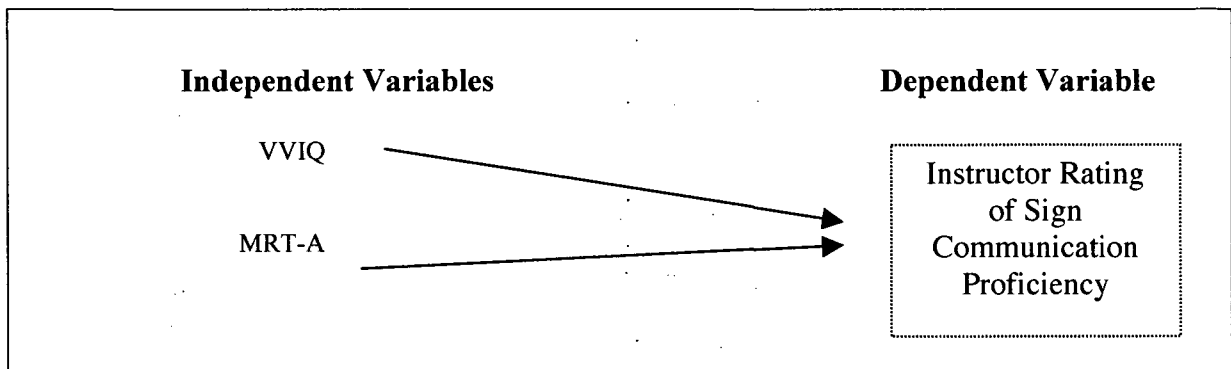
*Correlation Between Instructors' Ratings of Advanced Students' Sign Communication Proficiency and Scores on the VVIQ and MRT-A*

Variables	Instructors Rating	VVIQ	MRT-A
Instructors Rating	1.00	-0.15501	0.03058
VVIQ	-0.15501	1.00	0.05707
MRT-A	0.03058	0.05707	1.00

No significant correlation was found between instructors' SCPI ratings and students' scores on the VVIQ or the MRT-A. Furthermore, there was no significant correlation found between the VVIQ scores and the MRT-A scores.

# *VVIQ and MRT-A Association with Instructors' SCPI Ratings and Students' Self-Ratings of Student Communication Proficiency*

A final analysis was performed using a multiple regression analysis to determine the extent to which visual vividness and mental manipulation were associated with instructors' scores of students' sign communication proficiency (see Figure 6).



*Figure 6. Model showing the relationship among variables.*

*VVIQ and MRT-A Association with Instructors' SCPI Rating of Students' Communication Proficiency.* Data were analyzed using multiple linear regression ( $\alpha = 0.05$ ) to determine if the instructors' ratings on the SCPI could be predicted from the two independent variables: VVIQ score and MRT-A score (see Table 21).

Table 21

*Model for Prediction of Instructors' Sign Communication Proficiency Rating from VVIQ Scores and MRT-A Scores (N=156)*

Predictor Variable	R <sup>2</sup>	Adj R <sup>2</sup>	Beta	STD ER	t	p
VVIQ	0.003	-0.0097	-0.008	0.014	-0.57	0.57
MRT-A			-0.015	0.033	-0.44	0.66



Data yielded a regression formula equation of  $Y' = 5.20889 + -0.00767 X1(VVIQ) + -0.01472 X2(MRT-A)$ . Results indicated no significant association between the two independent variables (VVIQ and MRT-A) and the dependent variable, instructors' SCPI score ( $F=0.26$ ,  $p=0.7751$ ). The two variables together were not significant and produced no association with the instructors' SCPI rating of students; therefore, no individual analysis on each independent variable was warranted.

The squared multiple correlation coefficient ( $R^2$ ) was used to estimate the amount of variance in the outcome variable, instructors' SCPI ratings, explained by the model variable, VVIQ + MRT-A. The complete model with both variables accounted for less than 1% of the variance in the instructors' SCPI ratings ( $R^2=0.0033$ ).

*VVIQ and MRT-A Association with Students' SCPI Self-Ratings of Their Communication Proficiency.* Data were also analyzed using multiple linear regression ( $\alpha = 0.05$ ) to determine if students' self-ratings could be predicted from the two independent variables: VVIQ score and MRT-A score (see Table 22).

Table 22

*Model for Prediction of Students' Self-Report Sign Communication Proficiency Ratings from VVIQ Scores and MRT-A Scores (N=156)*

Predictor Variable	$R^2$	Adj $R^2$	Beta	STD ER	t	p
VVIQ	0.003	-0.010	0.007	0.013	0.55	0.58
MRT-A			-0.010	0.032	-0.32	0.75

Data yielded a regression formula equation of  $Y' = 3.89749 + -0.00710 X1(VVIQ) + -0.01019 X2(MRT-A)$ . Results indicated no significant association between the two

independent variables (VVIQ and MRT-A) and the dependent variable, students' self-report SCPI score ( $F=0.21$ ,  $p=0.8118$ ). The two variables together were not significant and produced no association with the students' SCPI self-rating; therefore, no individual analysis on each independent variable was warranted.

The squared multiple correlation coefficient ( $R^2$ ) was used to estimate the amount of variance in the outcome variable, students' SCPI self-ratings, explained by the model variable, VVIQ + MRT-A. The complete model with both variables accounted for less than 1% of the variance in the students' SCPI self-ratings ( $R^2=0.0027$ ).

### Summary

This chapter reported the results of this study investigating the relationship among beginning and advanced students of American Sign Language and credentialed interpreters on their visualization abilities, specifically across the two domains of visual vividness and mental manipulation via rotation. Demographic information indicated that there were significant differences among the groups on five variables: *age*, *ethnicity*, *parental hearing status*, *number of years of prior experience using ASL*, and *number of years of prior experience with Deaf professionals who use ASL*. There were no significant differences among the three groups regarding gender.

A significant difference was present in age between advanced ASL students and interpreters, and beginning ASL students and interpreters but not between beginning and advanced ASL students. This supports the premise that students as a group tend to be younger than working, credentialed interpreters.

The advanced ASL student group had a significantly higher number of minority students (Black, Hispanic, Asian, and Native American) than either the beginning ASL

students or the interpreters. There was no significant difference with regard to ethnicity between the beginning ASL students and the interpreters.

The credentialed interpreters as a group had a significantly higher percentage of deaf parents than either ASL student group. This corresponds to the field's history whereby early professional interpreters tended to be children of deaf parents who were native users of ASL. The increased demand for more interpreters over the years created the need to teach ASL to hearing persons who did not grow up with the language (Frishberg, 1990).

Credentialed interpreters had significantly higher number of years of prior experience with deaf professionals who use ASL than beginning ASL students. No significant differences were reported between beginning and advanced students, or advanced students and interpreters.

Both instructor-rated and student self-rated language competency levels were evaluated to investigate the premise that the advanced ASL students possess higher language competency skills than the beginning ASL students. Results indicated that both advanced students and their instructors rated advanced students' language competency significantly higher than the beginning students and their instructors.

No significant differences were found among beginning students, advanced students and credentialed interpreters on either the VVIQ or the MRT-A. When beginning students were evaluated against the credentialed interpreter, however, significant differences were reported on the VVIQ. This did not hold true for the MRT-A.

There was no significant correlation between students' VVIQ scores or students' MRT-A scores and instructors' rating of student language competency level. Neither

students' VVIQ scores nor MRT-A scores could account for any significant portion of students' self-rating or instructors' rating of sign language competency.

The results of this study report that there were no significant differences among beginning ASL students, advanced ASL students, and credentialed interpreters across the two domains of visual vividness and mental rotation as measured by the VVIQ and the MRT-A. When the intermediary groups (advanced ASL students and state-credentialed interpreters) were removed and analysis was conducted between beginning ASL students and nationally certified interpreters, a discernable and significant difference was reported. Nationally certified interpreters scored significantly higher on visual vividness than did beginning ASL students as measured by the VVIQ. A similar analysis was conducted between beginning ASL students and nationally certified interpreters using the MRT-A; however, no significant difference in mental rotation was reported.

## **CHAPTER FIVE: DISCUSSION**

This study investigated the relationship among beginning and advanced ASL students and credentialed interpreters across two visual imagery domains: vividness and control. These two domains represent measurable characteristics that correspond to the two-part definition used in this study; that is, visualization is the ability to create and manipulate visual images in the mind (Marks, 1972; McKim, 1972). This concluding chapter includes a summary of the study; discussion of the findings; delimitations, limitations, threats to validity; and recommendations for further research based on the findings in this study.

### **Summary of the Study**

This study was initiated to test the hypothesis that visualization abilities are a foundational aptitude for learning a signed language and that measurements of these skills increase as students progress from beginning language classes through advanced language learning and ultimately through professional interpreter credentialing. While studies have been conducted on the difference in visualization abilities between deaf adults, hearing adults, and hearing children of deaf parents, no studies have been conducted investigating the visual abilities of sign language students and interpreters. If discernible differences exist among beginning and advanced ASL students and credentialed interpreters, this knowledge will be helpful for student advising, recruitment, retention, and interpreter curricular development, and will contribute to the gap in knowledge regarding students' visualization abilities.

One hundred and fifty-four students and credentialed interpreters from four states (AR, OK, LA, TX) participated in this study measuring vividness of visual imagery and

manipulation of mental images using the VVIQ and the MRT-A respectively. Ninety ASL 1 students, 66 ASL 3 and 4 students and 68 credentialed interpreters (state screened or nationally certified) completed the two instruments. Additionally both students and their instructors completed a rating of the students' sign communication proficiency using the SCPI rating scale. All participants completed demographic questions regarding their age, gender, ethnicity, parental hearing status, number of years using ASL, number of years working with deaf adults who use ASL, and their interpreting credential(s), if any.

Results indicate that the three groups of participants, beginning ASL students, advanced ASL students, and credentialed interpreters, did not vary significantly on gender. Participants were mostly female and Caucasian, similar to the results of previous studies of interpreter characteristics. Participants did vary on other characteristics with interpreters being significantly older than either group of ASL students and having more deaf parents than the students. Additionally credentialed interpreters had more years of prior experience with ASL and with deaf professionals who use ASL than did the students.

Students and their instructors rated students' sign communication proficiency similarly. Beginning ASL students were rated significantly lower in their sign communication skills than the advanced ASL students by both instructors' ratings and students' self-rating.

### Research Questions

Four research questions were investigated.

1. What is the relationship between students' vividness and manipulation of visual imagery and status in university level ASL classes?

2. What is the relationship between credentialed interpreters' vividness and manipulation of visual imagery and that of beginning and advanced students of ASL?
3. What is the relationship between students' vividness and manipulation of visual imagery and ASL instructors' evaluation of sign communication proficiency?
4. Are students' measures of imagery and vividness predictive of instructors' ratings of students' sign language competency?

*Relationship Between Students' Vividness and Manipulation of Visual Imagery and Status in University Level ASL Classes*

There was no significant relationship between beginning and advanced students with respect to either the VVIQ or the MRT-A. Neither of these instruments detected significant differences between beginning and advanced ASL leading to a failure to reject the null hypothesis.

*Relationship Between Credentialed Interpreters' Vividness and Manipulation of Visual Imagery and that of Beginning and Advanced Students of ASL*

There was no significant relationship between beginning or advanced ASL students and credentialed interpreters with respect to either the VVIQ or the MRT-A. There was suggestive evidence of an increase in mean VVIQ scores from beginning ASL students to advanced ASL students to credentialed interpreters (means = 63.6, 64.6, and 66.0 respectively), but the increase did not rise to the level of significance. This trend decreased from beginning ASL students to advanced ASL students to credentialed interpreter for the MRT-A (means = 11.3, 11.2, and 10.3 respectively).

When the intermediary groups of advanced ASL students and state-credentialed interpreters were removed and analysis was conducted between beginning ASL students and

nationally certified interpreters, a significant difference was reported. Certified interpreters scored significantly higher than beginning ASL students on vividness of visual imagery as measured by the VVIQ. A similar analysis using the MRT-A did not result in any significant difference between the beginning ASL students and the nationally certified interpreters.

*Relationship Between Students' Vividness and Manipulation of Visual Imagery and ASL Instructor's Evaluation of Students' Sign Communication Proficiency*

There was no significant relationship reported between the students' test scores and instructors' ratings on the SCPI. Neither the students' self-rating on the SCPI nor the instructors' SCPI ratings could be accounted for by either the VVIQ, the MRT-A or by both scores combined.

*Students' Measures of Imagery and Vividness as a Predictor of Instructors' Rating of Students' Sign Language Competency*

There was no evidence that the students' vividness scores or mental rotation scores were predictive of instructors' rating of language competency. This held true for each variable and for both variables analyzed together. The complete model with both variables accounted for less than 1% of the variance in the instructors' SCPI ratings ( $R^2=0.0033$ ) as well as the students' SCPI self-ratings ( $R^2=0.0027$ ).

## Discussion

The findings from this study did not support the hypothesis that visualization is a variable discernible among beginning and advanced ASL students and credentialed interpreters. The study did, however, report a significant difference between beginning ASL students and nationally certified interpreters on visual vividness, but not on mental rotation. The following discussion addresses avenues for further testing of the merits of this



hypothesis. Additionally, the application of the significant relationship identified in this study between students' and instructors' ratings of students' sign communication proficiency is discussed.

*Measuring Students' Visual Imagery Skills: Global Construct or System of Domain Subsets*

For this study, visualization was measured across two domains: vividness and manipulation. It is possible that other visual domains or visual system subsets may be more closely related to learning ASL. This, in turn, may lead to identifying other possible measurement tools to identify visual-gestural language aptitude. For example, Blajenkova, Kozhevnikov, and Motes (2006) propose that visual imagery ability is not one global construct, but rather visual imagery has subsystems of *object imagery* and *spatial imagery*.

The authors describe these two imagery types as:

...object imagery refers to representations of the literal appearances of individual objects in terms of their precise form, size, shape, colour and brightness, whereas spatial imagery refers to relatively abstract representations of spatial relations among objects, parts of objects, locations of objects in space, movement of objects and object parts and other complex spatial transformations. (pp. 230-240)

The researchers have proposed a 30-item scale to distinguish between those who prefer *object imagery* and those who prefer *spatial imagery*. *Object imagery* as defined above by Blajenkova, et al. (2006) reflects many of the characteristics of vividness as defined for this study -- the richness in detail contained in the representations from which images are generated (Baddeley & Andrade, 2000; D'Angiulli & Reeves, 2002). *Spatial imagery* as defined above by Blajenkova, et al. (2006) reflects the movement of objects and use of space similar to the definition of manipulation of mental imagery adopted in this study --the controllability of changes in mental images (Griffitts, 1927 as cited in Richardson, 1969). The current study should be replicated using this measure of *object imagery* and *spatial*

*imagery* to further test the hypothesis that there are significant differences in imagery ability among beginning and advanced ASL students and credentialed interpreters. It would be interesting to see if one or both types of imagery are correlated to sign language competency.

Another possibility is that mental rotation of objects, a measurement used in this study, is not the same as mental rotation in linguistic contexts. Kosslyn, Klima, and Hickok (1998) postulate that ASL signers do not consciously rotate images but rather instantaneously “re-position” an image from the signer’s perspective. These authors postulate that using ASL may influence various cognitive processes rather than strong cognitive processes influence one’s ability to learn ASL. In other words, it may be that the study of ASL enhances students’ visual skills, rather than strong visual skills enhance students’ ability to learn ASL.

Previous studies have failed to find a relationship between self-reports of imagery vividness and imagery task performance such as spatial imagery or mental rotation (Dean & Morris, 2003; McKelvie, 1995; Richardson, 1977). Some researchers suggest that the VVIQ is associated with visual memory, not imagery vividness (McKelvie, 1995). Others claim that this measure is too global in nature and does not differentiate individual differences on key subcomponents of visual vividness (Rodway, Gillies, & Schepman, 2006).

Regardless of the differing theories presented by researchers, Rodway et al. (2006) state that appropriate relationships can be obtained between self-reports of vividness and visual behavioral tasks. More studies are needed, however, to ascertain the appropriate behavioral tasks that can be correlated with visual vividness. Specifically there is a need for further studies to identify instruments to detect individual visualization differences and discriminate between vivid and non-vivid imagers.

Rodway et al. (2006) state further that the VVIQ may be a reasonable measure of

global vividness. Their study focused not on mental rotation as a corresponding behavioral task, but on the ability of vivid and non-vivid imagers to detect whether changes had been made to pictures, and if so, what kind of changes. They reported that vivid imagers are better at detecting salient changes in pictures but do not have high levels of recall for details. It is possible in this study that mental rotation was not an appropriate visual task to measure, and that some other mental imagery task can better distinguish between ASL students and credentialed interpreters.

Promising studies that measure brain activity during visual imaging may, in fact, hold the key to distinguishing between high visual imagers and low visual imagers. Cui, Jeter, Yang, Montague, and Eagleman (2007) reported that VVIQ scores correlated with MRI results during visual cortex activity. Research into the physical changes that occur in the brain when visualizing or when applying visual imagery to psycho- or behavioral problems may have the potential to quickly and objectively measure individual differences.

This study was not directed at investigating a relationship between visual vividness and behavioral tasks, or associated brain activity. Rather, the goal was to operationalize a two-part definition of visualization (the ability to create and manipulate visual images) to measure differences among beginning and advanced ASL students and credentialed interpreters in their ability to visualize given the visual linguistic requirements of ASL. Reported results did not reach significance; however, there were some interesting trends noted.

In this study there was suggestive evidence of a positive upward trend between participant status and the mean scores of the VVIQ. The VVIQ measured significant differences between beginning ASL students and nationally certified interpreters, but did not

report significant incremental differences between intermediary groups such as beginning and advanced ASL students or advanced ASL students and state-credentialed interpreters. More studies are needed to identify more sensitive tools for measuring significant incremental differences among groups such as beginning and advanced ASL students, and state credentialed and nationally certified interpreters.

It is interesting to note a suggestive negative trend between participant status and the means scores of the MRT-A, an objective test of mental rotation. Credentialed interpreters reported a lower mean score (10.32) than the advanced ASL students (11.23), and the advanced ASL students reported a lower mean score than the beginning ASL students (11.32). While the literature reports that males tend to score higher than women on tests of mental manipulation (Burton, Henninger, & Hafetz, 2005), and age is associated with decreased speed and accuracy on mental imagery tasks (Craik & Dirks, 1992; Dror & Kosslyn, 1994), there is no suggestive evidence that either characteristic overtly influenced these results. Males accounted for 19% of the participants with no significant differences among the three groups. Although there were significant differences regarding age among the groups, the mean ages ranged from 26.8 years for the beginning students to 29.4 years for the advanced students to a high of 40.5 years for the interpreters. Studies indicating significant differences in visual abilities by age reported much larger ranges in ages.

#### *Relationship Between ASL Students' and Instructors' Perception of Language Competency*

A secondary theme in this study was the investigation of the perceptions of both students and instructors regarding students' sign language competency. One analysis did produce significant results. The reported relationship regarding student competency levels did, in fact, distinguish between beginning and advanced ASL students. Advanced ASL

students scored significantly higher than beginning ASL students when measured by both students' SCPI self-rating and instructors' SCPI ratings.

Additionally students and instructors were highly correlated on students' SCPI levels. This was true for both beginning and advanced ASL students and all students as a whole. The practical conclusion is that in this study, students and instructors both evaluated students' sign communication proficiency similarly. This information is of interest for interpreter education programs and sign language classes that include both student self-rated evaluation and instructor-rated evaluation methodology. If students evaluate their own skills similarly to their instructor's evaluation, then more self-evaluation can be included in graded classroom performance. This encourages life-long self-evaluation skills long after the students have left the classroom and the instructor.

*Relationship Between Students' Visualization Scores and ASL Instructor's Evaluation of Students' Sign Communication Proficiency*

There were no significant differences between the beginning and advanced ASL students' ability to visualize as measured in this study by the VVIQ and the MRT-A. Consequently, there was no relationship between the students' visualization scores and their instructors' evaluation of students' sign communication proficiency. Future studies are warranted to identify other instruments that can support the hypothesis that there is a relationship between students' visualization ability and their instructors' evaluation of students' sign language proficiency. It may be, however, that the domains of vividness and mental rotation do not constitute the core visual imagery subsets associated with visual language learning.

## Limitations and Threats to Validity

### *Delimitations*

Delimitations are characteristics of the study that the researcher did not intend to accomplish, or that limit the scope or boundary of the study. This study was intended to determine if there is a relationship between ASL students' and credentialed interpreters' ability to visualize and their status on the language learning continuum. This study was not designed to investigate, nor can it determine, if students who are visual are attracted to ASL classes, do better than non-visual ASL students in their course work, or if students develop visualization skills through their language progression. It cannot be determined if students' ASL skills improve because of sign language instruction or if students with strong language aptitude or sign language skills persevere through the ASL sequence while those with weaker skills drop out.

### *Limitations*

As with any research, there were several limitations with this study. Limitations are those characteristics of the design methodology that may influence the results and limit the generalizability of the results to other groups or to the population as a whole. While every effort was made to sample students in a multi-state region, it is surmised, but cannot be proven, that these students were a representative sample of the population of ASL students and credentialed interpreters.

One limitation may well be the adoption of a definition of *advanced ASL students* as those enrolled in ASL 3 or ASL 4. In general the class enrollments in the programs sampled reflected the regional data that beginning ASL student outnumber advanced ASL students (Furman, et al., 2007). Some programs offered ASL 4 only during the spring semester

putting those students beyond the scope of this researcher to test. Multiple ASL 1 classes, however, were offered each semester. Due to the low number of advanced ASL classes, and the low student enrollment in these classes, data were collected from all upper level students present on the day of testing at each site, while students in only one or two of the beginning ASL classes were tested. It is possible that the inclusion of ASL 3 students in the definition of *advanced ASL students* obscured real differences between ASL 1 and ASL 4 students, given that their language study falls between ASL 1 and ASL 4.

Another limitation of this study related to the time of day the participants completed the two instruments. While all students were tested during their regularly scheduled ASL class, some students were tested in the morning hours, some in the afternoon hours, and some in the evening. It is not known how fatigue may have influenced students' test scores.

Self-report questionnaires, as reported previously, present numerous limitations. Some of these are due to: (a) the influence of perceived social desirability, (b) challenges in measuring individual differences to the same stimulus (e.g., what one person may consider "very vivid" may be considered by another person as "somewhat vivid," (c) the accuracy of individuals' subjective evaluation of their internal event, and (d) the influence of acquiescence, that is, it is often easier to say "yes" than "no" (Ashton & White, 1975; Di Vesta, et al., 1971; Ernest, 1977; Kaufmann, 1981; Moran, 1993). Although the directions given to each group were the same, it is not possible to know how each participant internalized the instructions or how participants evaluated the rating scales of the VVIQ. It is also anticipated that some students' and interpreters' ratings of vividness were influenced by their desire to please the investigator or to appear highly visual.

Motivation to perform is also highly variable and may have influenced results on both the VVIQ and the MRT-A. Some students appeared eager to participate while others, especially some ASL 1 students, appeared less interested when they found out that participation would not influence their course grade. Interpreters as a whole appeared eager to participate. All participants had the option to not participate or to withdraw during testing, and in several cases a few students declined to participate. Later one student, when asked why he chose not to participate, indicated that he worked two jobs in addition to attending school and simply did not want to waste his mental energy before going to his night job after class. On two occasions, a student left in the middle of the tests for unknown reasons, never completing the two instruments.

#### *Threats to Validity*

In this study, threats to validity were minimized by grounding the study in clearly stated theory, and by utilizing two instruments with long history of use in prior studies. Both the MRT-A and the VVIQ have been extensively used in scientific study. The MRT-A is based on the Vandenberg and Kuse Mental Rotations Test that is considered the "...classic test of 3-D mental rotation" (Halper, 2009, p. 40). A meta-analysis of the VVIQ (McKelvie, 1995) reported high reliability, content validity and criterion validity, with adequate internal consistency and generally free of bias from social desirability.

According to Lavrakas (2008), there are several threats to external validity when engaged in survey research that can limit generalizability. Some of these threats are applicable to this study. They include (a) setting characteristics, (b) temporal characteristics, and (c) multiple-treatment interference.



Setting characteristics refer to the unique characteristics of the setting in which the study took place that may influence the results. One way to minimize *setting threat* is to survey participants across different sites and at different times. In this study, setting threat was reduced by testing students at postsecondary interpreter education programs in four states. All participants were tested, however, in similar environments. Students were tested in their regular ASL classroom, and interpreters were tested in classrooms or conference rooms with classroom setup. *Temporal threat* implies that different results would have been obtained if the tests were given at a different time. The best way to address temporal threats is to test at multiple times. To reduce temporal threat some students were testing in the morning, some in the afternoon and some evenings. *Multiple treatment interference* occurs when participants are administered more than one survey whereby sequencing may impact results. In this study the subjective self-report survey was always administered first followed by an objective test of mental rotation. This decision was made on the belief that the objective test would be less impacted by self-perception or raised awareness of visual vividness, whereas the self-report test might be influenced by how the individual felt he or she performed on the timed, objective test of mental rotation.

#### Recommendations for Future Research

Based on the results of this study and the information learned during the course of this study, there are a number of recommendations that can be made. They are:

*Recommendation 1: Conduct further research to identify foundational aptitudes for learning a signed language.* Further research is needed to identify foundational aptitudes for learning a visual-gestural language, and, in particular, how strength of visualization ability is situated within those aptitudes. It is reasonable to assume that visualization ability is only one

aptitude variable for learning a signed language. Recent and ongoing studies have identified personality characteristics, cognitive attributes, and general language ability as components of sign language learning aptitude. (Bontempo, 2008; Gomez, et al., 2007; Stone, 2009). Research needs to continue to study these and other variables that may affect visual language learning and interpretation.

*Recommendation 2: Explore aspects of standardized tests of language aptitude that may be applicable to testing sign language aptitude.* Tests exist to measure foreign language learning aptitude such as the Modern Language Aptitude Test (MLAT) and the Pimsleur Language Aptitude Battery (Second Language Testing Incorporated, n.d.). These, however depend upon, in part, auditory and verbal skills precluding all or part of their use for visual languages. More studies need to be conducted to address tests of sign language aptitude such as the longitudinal study being conducted by Stone (2009). Stone is exploring language aptitude and modality specific aptitude (signed and spoken) among British sign language interpreters.

*Recommendation 3: Conduct further research to identify global or system sub-components of visualization ability related to learning a visual-gestural language.* There is a plethora of research devoted to identifying and measuring global and discrete visual imagery abilities. No consensus has been reached, however, on the relationship of subsystems of imagery such as visual memory, visual vividness, or visual manipulation, and their relationship to performance tasks such as problem solving, mental rotation or linguistic use. No studies have addressed visualization skills as a foundational aptitude for learning a signed language despite studies that identify visual imagery as a linguistic component of ASL (Emmorey, et al., 1993; Emmorey, 2002).

*Recommendation 4: Identify or develop new tools to accurately measure visualization skills (global and specific) that are determined to be associated with the ability to learn a signed language.* If, as hypothesized, strong mental imagery is a characteristic of sign language interpreters, then further research is warranted to identify and develop valid and reliable instruments to measure these visual abilities. A new version of the VVIQ, the VVIQ-2, with 32 items (compared to the 16 items in the VVIQ) was developed by Marks (1995) as an improvement on the original VVIQ. Instead of four scenarios that are visualized with eyes open, and then repeated with eyes closed, the 8 scenarios of the VVIQ-2 are visualized once. The increased number of scenarios test greater visualization applicability such as visualizing landscapes, objects, details, and actions. This instrument, highly correlated with the original VVIQ (Campos & Pérez-Fabello, 2009), may provide a better analysis of individuals' visualization abilities than the more limited VVIQ.

Other tools also may show promise. For example, Blajenkova et al. (2006) developed a 30-item scale to distinguish between those who prefer *object imagery* and those who prefer *spatial imagery*. Perhaps signed language learning aptitude is more highly correlated with one type of imagery or the other.

It may well be that a new global instrument measuring individual differences that target a wide array of visualization skills used in daily living could prove defining for the field. I have been interested in developing a self-report instrument that measures different types of imagery such as *memory, imagination, daydreams, eidetic imagery, symbolic imagery*, etc. related to everyday experiences and decision making. I envision developing and validating an instrument whereby test-takers will rate their visual abilities on a Likert-scale to reflect their own preferences and experiences in applying visualization to daily tasks. Such

questions might include, *“When I seek directions, I am likely to use a map.” “I enjoy photography, art.” “When playing an instrument from memory, I read the sheet music in my head including visually turning the pages.” “I can mentally rearrange the furniture in my living room to see if I like the arrangement.” “I have mental representations for abstract concepts such as the days of the week or the months in the year” and “Some streets I drive are visually overwhelming.”*

Still other measures that are more objective have promise. Computer generated objective tests of visualization ability should be explored as well as tests of cortical stimulation that occur during various visualization tasks. These tests may obviate the need for self-report measures, or, may provide supplemental, objective data that enhance self-report results.

*Recommendation 5: Repeat this study with a larger sample of students and interpreters targeting only ASL 1 students and nationally certified interpreters (RID, NAD, EIPA).* It appears that the inclusion of ASL 3 students in the definition of *advanced ASL students*, and the inclusion of interpreters with lower level state credentials (e.g., QAST levels) in the definition of *credentialed interpreters* obscured possible differences among the participant groups and real differences between the beginning and most advanced groups. Replicating this study with more restrictive definitions of student groups and interpreters may produce stronger results.

*Recommendation 6: Conduct a longitudinal study of beginning sign language students, following them throughout their language learning progression.* A longitudinal study could investigate the relationship between beginning students’ visualization abilities and their success in progressing through sequential ASL classes to interpreting classes and

ultimately to professional certification. A mixed methods study could include a qualitative component that also explores students' reasons for studying ASL, factors that contribute to persistence through the program, and reasons for student attrition.

### *Conclusion*

Further research will add to the body of knowledge of requisite skills and aptitudes required to successfully learn a visual-gestural language. This will be advantageous to interpreter education programs seeking to attract students to the field of interpretation and provide useful information for the collegiate advising process. This, in turn, will inform the field of interpreter education pedagogy and influence curricular development.

Hopefully this study will encourage others to investigate the role of students' visualization skills in learning ASL. It is also hoped that it may entice future researchers to further address aptitude components relevant to becoming successful sign language students and professional interpreters. Lastly, it is hoped that this research will foster further research on the various aspects of mental imagery especially related to the measurement of individual differences and the application of mental imagery skills to learning a visual-gestural language.

## References

- Abell, C., & Currie, G. (1999). Internal and external pictures. *Philosophical Psychology*, 12(4), 429-445.
- Ashton, R., & White, K. (1975). The effects of instructions on subjects' imagery questionnaire scores. *Social Behavior and Personality: An International Journal*, 3(1), 41-43.
- Baddeley, A., & Andrade, J. (2000). Working memory and the vividness of imagery. *Journal of Experimental Psychology*, 129(1), 126-145.
- Baker, C., & Cokely, D. (1980). *American Sign Language: A teacher's resource text on grammar and culture*. Silver Spring, MD: T.J. Publishers, Inc.
- Beebe, M. (2009). [Governor's] State of the State Address, January 13, 2009. Retrieved January 19, 2009 [http://governor.arkansas.gov/newsroom/index.php?do:newsDetail=1&news\\_id=1384](http://governor.arkansas.gov/newsroom/index.php?do:newsDetail=1&news_id=1384)
- Betz, N. (2005). Women's career development. In S. Brown & R. Lent (Eds.), *Career development and counseling* (pp. 253-277). Hoboken, NJ: John Wiley & Sons, Inc.
- Bialystok, E., & Hakuta, K. (1994). *In other words: The science and psychology of second-language acquisition*. New York: BasicBooks, A Division of HarperCollins Publishers, Inc.
- Blajenkova, O., Kozhevnikov, M., & Motews, M. (2006). Object-spatial imagery: A new self-report imagery questionnaire. *Applied Cognitive Psychology*, 20, 239-263.
- Blake, J. (n.d.). Personality type and interpreters for the deaf. Retrieved March 19, 2005 from <http://theinterpretersfriend.org/pd/personality.html>
- Bontempo, K. (2008, October). *Personality matters! Measuring performance predictors in signed language interpreters*. Poster session presented at the biennial conference of the Conference of Interpreter Trainers, San Juan, Puerto Rico.
- Briggs, S. D., Raz, N., & Marks, W. (1999). Age-related deficits in generation and manipulation of mental images: I. the role of sensorimotor speed and working memory. *Psychology and Aging*, 14(3), 427-435.
- Brownlow, S., McPherson, T. K., & Acks, C. (2003). Science background and spatial abilities in men and women. *Journal of Science Education and Technology*, 12(4), 371-380.
- Burton, L., (2003). Examining the relation between visual imagery and spatial ability tests. *International Journal of Testing*, 3, 277-291.

- Burton, L, Henninger, D., & Hafetz, J. (2005). Gender differences in relations of mental rotation, verbal fluency, and SAT scores to finger length ratios as hormonal indexes. *Developmental Neuropsychology*, 28(1), 493-505.
- Bywaters, M., Andrade, J., & Turpin, G. (2004). Determinants of the vividness of visual imagery: The effects of delayed recall, stimulus affect and individual differences. *Memory*, 12(4), 479-488.
- Caccamise, F. & Samar, V. (2009). Sign Language Proficiency Interview (SLPI): Prenegotiation interrater reliability and rater validity. *Contemporary Issues in Communication Science and Disorders*, 36, 36-47.
- Campos, A. (1998). A measure of visual imaging capacity: A preliminary study. *Perceptual and Motor Skills*, 87, 1012-1014.
- Campos, A., Gonzales, M., & Amor, A. (2002). The Spanish version of the Vividness of Visual Imagery Questionnaire: Factor structure and internal consistency reliability. *Psychological Reports*, 90, 503-506.
- Campos, A. & Pérez-Fabello, M.. (2009). Psychometric quality of a revised version Vividness of Visual Imagery Questionnaire. *Perceptual and Motor Skills*, 108(3), 798-802.
- Chan, D. W. (2007 Summer). Gender differences in spatial ability: Relationship to spatial experience among Chinese gifted students in Hong Kong. *Roeper Review*, 29(4), 277-282.
- Chandrasekaran, B. & Narayanan, N. (1990). Integrating imagery and visual representations. *Proceedings of the 12<sup>th</sup> annual conference of the Cognitive Science Society*. (pp. 670-677). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Chara, P. J., & Verplanck, W. A. (1986). The Imagery Questionnaire: An investigation of its validity. *Perceptual and Motor Skills*, 63, 915-920.
- Clément, R., Dörnyei, Z., & Noels, K. (1994). Motivation, self-confidence, and group cohesion in the foreign language classroom. *Language Learning*, 44(3), 417-448.
- Cokely, D., & Winston, E. (2008). *Interpreter education programs needs assessment: Final report*. Boston, MA: Northeastern University, National Interpreter Education Center.
- Collins, D., & Kimura, D. (1997). A large sex difference on a two-dimensional mental rotation task. *Behavioral Neuroscience*, 111(4), 845-849.
- Cooper, C. L. (2004). *Development and validation of the Cooper Quality of Imagery Scale: A measure of vividness of sporting mental imagery*. (Doctoral Dissertation). Retrieved from Dissertation Abstracts International, 65(09), 4822B. (UMI No. 3145185)

- Craik, F., & Dirkx, E. (1992). Age-related differences in three tests of visual imagery. *Psychology and Aging*, 76, 661-665.
- Cui, X., Jeter, C., Yang, D., Montague, P., & Eagleman, D. (2007). Vividness of mental imagery: Individual variability can be measured objectively. *Vision Research*, 47, 474-478.
- D'Angiulli, A., & Reeves, A. (2002). Generating visual mental images: Latency and vividness are inversely related. *Memory & Cognition*, 30, 1179-1188.
- Dean, G., & Morris, P. (2003) The relationship between self-reports of imagery and spatial ability. *British Journal of Psychology*, 94(2), 245-273.
- Di Vesta, F., Ingersoll, G. & Sunshine, P. (1971). A factor analysis of imagery tests. *Journal of Verbal Learning and Verbal Behavior*, 10, 471-585.
- Dror, I., & Kosslyn, S. (1994). Mental imagery and aging. *Psychology and Aging*, 9(1), 90-102.
- Emmorey, K. (2002). Mental imagery and embodied cognition: Insights from sign language research. *Journal of Mental Imagery*, 26(1 & 2), 50-53.
- Emmorey, K. (2004). *Language, cognition, and the brain: Insights from sign language research*. Mahway, NJ: Lawrence Erlbaum Associates Publishing.
- Emmorey, K., Grabowski, T., McCullough, S., Ponto, L., Hichwa, R., & Dzmasio, H. (2005). The neural correlates of spatial language in English and American Sign Language: a PET study with hearing bilinguals. *NeuroImage*, 24, 832-340.
- Emmorey, K., Klima, E., & Hickok, G. (1998). Mental rotation within linguistic and non-linguistic domains in users of American Sign Language. *Cognition*, 68, 221-246
- Emmorey, K., & Kosslyn, S. (1996). Enhanced image generation abilities in deaf signers: A right hemisphere effect. *Brain and Cognition*, 32, 28-44.
- Emmorey, K., Kosslyn, S., & Bellugi, U. (1993). Visual imagery and visual-spatial language: Enhanced image abilities in deaf and hearing ASL signers. *Cognition*, 46, 139-181.
- Ernest, C. (1977). Imagery ability and cognition: A critical review. *Journal of Mental Imagery*, 2, 181-216.
- Finke, R. (1989). *Principles of mental imagery*. Cambridge, MA: MIT Press.
- Foss, K., & Reitzel, A. (1998). A relational model for managing second language anxiety. *TESOL Quarterly*, 22(3), 437-454.



- French, F. (1902). Mental imagery of students: A summary of the replies given to Tichener's questionnaire by 118 juniors in Vassar college. *Psychological Review*, 9(1), 40-56.
- Frishberg, N. (1990). *Interpreting: An introduction* (3<sup>rd</sup> ed). Silver Spring, MD: RID Publications.
- Furman, N., Goldberg, D., & Lusin, N. (2007). *Enrollments in languages other than English in United States institutions of higher education: Fall 2006*. New York: The Modern Language Association of America.
- Gan, Z., Huphreys, G., & Hamp-Lyons, L. (2004). Understanding successful and unsuccessful EFL students in Chinese universities. *The Modern Language Journal*, 88(2), 229-244.
- Gao, C. (2001) Second language learning and the teaching of grammar. *Education*, 122, 326-336.
- Geiser, C., Lehmann, W., & Eid, M. (2006). Separating "rotators" from "nonrotators" in the Mental Rotations Test: A multigroup latent class analysis. *Multivariate Behavioral Research* 41(3), 261-293,
- Geiser, C., Lehmann, W., & Eid, M. (2008). A note on sex differences in mental rotation in different age groups. *Intelligence*, 36, 556-563.
- Gómez, M., Molina, T., Benítez, P., & Santiago, J. (2007). Predicting proficiency in signed language interpreting. *Interpreting*, 9(1), 71-93.
- Halper, E. (2009). *The nature of relationships between mental rotation, math and language in deaf signers*. (Doctoral dissertation). Retrieved from ProQuest LLC. (UMI No. 3388611)
- Hatcher, L. (2003). *Step-by-step basic statistics using SAS*. Cary, NC: SAS Institute, Inc.
- Hiscock, M. (1978). Imagery assessment through self-report: What do imagery questionnaires measure? *Journal of Consulting and Clinical Psychology*, 46(2), 223-230.
- Isaac, A., & Marks, D. (1994). Individual differences in mental imagery experience: Developmental changes and specialization. *British Journal of Psychology*, 85, 479-500.
- Isaac, A., Marks D., & Russell, D. (1986). An instrument for assessing imagery of movement. The Vividness of Movement Imagery Questionnaire. *Journal of Mental Imagery*, 10, 23-30.
- Isenhath, J. (1990). *The linguistics of American Sign Language*. Jefferson, NC: McFarland & Company, Inc.

- Ivars, J., & Calatayud, D. (2001). "I failed because I got very nervous." Anxiety and performance in interpreter trainees: An empirical study. *The Interpreters' Newsletter*, 11, 105-118.
- Jones, B. (1993). Responsibilities of educational sign language interpreters in K-12 public schools in Kansas, Missouri and Nebraska. (Unpublished doctoral dissertation) University of Kansas, Kansas.
- Jones, B. (1997). Characteristics and practices of sign language interpreters in inclusive educational programs. *Exceptional Children*, 63(2), 257-268.
- Kaufmann, G. (1981). What is wrong with imagery questionnaires? *Scandinavian Journal of Psychology*, 22, 59-64.
- Kihlstrom, J., Glisky, M., Peterson, M., Harvey, & Rose, P. (1991). Vividness and control of mental imagery: A psychometric analysis. *Journal of Mental Imagery*, 15(3 & 4), 133-142.
- Kosslyn, S. (1980). *Image and mind*. Cambridge, MA: Harvard University Press.
- Kosslyn, S. (1994). *Image and brain: The resolution of the imagery debate*. Cambridge, MA: The MIT Press.
- Kosslyn, S., Thompson, W., & Gains, G. (2006). *The case for mental imagery*. New York: Oxford University Press.
- Krug, K., Shafer, T., Dardick, W., Magalis, C., & Parantè (2002). A test of foreign language acquisition: Paired-association learning. *Applied Cognitive Psychology*, 16, 211-221.
- Lang, H., Foster, S., Gustina, D. Mowl, G., & Liu, Y. (1996). Motivational and attitudinal orientations in learning American Sign Language. *Journal of Deaf Studies and Deaf Education*, 1(2), 37-144.
- Lavrakas, P. (Ed.). (2008). *Encyclopedia of survey research methods* (vol. 2). Thousand Oaks, CA: SAGE Publications, Inc.
- Lequerica, A., Rapport, L., Axelrod, B., Telmet, K., & Whitman, R. (2002). Subjective and objective assessment methods of mental imagery control: Construct validation of self-report measures. *Journal of Experimental Neuropsychology*, 8, 1103-1116.
- Libby, L., & Eibach, R. (2008). Seeing the links among the personal past, present and future: How imagery perspective in mental simulation functions in defining the temporally extended self. In K. Markman, W. Klein, & J. Suhr (Eds.), *Handbook of imagination and mental simulation* (pp. 359-372). London: Taylor & Francis, Inc.

- Liddell, S. (1990). Four functions of a locus: Re-examining the structure of space in ASL. In C. Lucas (Ed.), *Sign language research, theoretical issues*. Washington, DC: Gallaudet University Press. (pp. 176-198).
- Linn, M., & Petersen, A. (1985). Emergence and characterization of sex differences in spatial ability: A meta-analysis. *Child Development*, 56, 1479-1498.
- Long, G., Stinson, M., Kelly, R. and Liu, Y. (1999). The development and psychometric properties of the American Sign Language Proficiency Assessment (ASL-PA). *Journal of Deaf Studies and Deaf Education*, 4(4), 249-269.
- Macnamara, B. (2008). Interpreter cognitive aptitudes. In L. Roberson & S. Shaw (Eds.). *17<sup>th</sup> national convention of the Conference of Interpreter Trainers: Putting the pieces together: A collaborative approach to education excellence* (pp. 33-50). Conference of Interpreter Trainers.
- Macnamara, B. (2008-2009). Interpreter cognitive aptitudes. *Journal of Interpretation*, p. 9-32.
- Marks, D. (1972). *Vividness of Visual Imagery Questionnaire (VVIQ)*. Retrieved online September 4, 2006 from <http://www.staff.city.ac.uk/d.marks/vviq.htm>
- Marks, D. (1977). Imagery and consciousness: A theoretical review from an individual differences perspective. *Journal of Mental Imagery*, 1, 275-290.
- Marks, D. (1999). Consciousness, mental imagery and action. *British Journal of Psychology*, 90, 567-585.
- McKee, R., & McKee, D. (1992). What's so hard about learning ASL?: Students' and teachers' perceptions. *Sign Language Studies*, 75, 129-157.
- McKelvie, S. (1995). The VVIQ as a psychometric test of individual differences in visual imagery vividness: A critical quantitative review and plea for direction. *Journal of Mental Imagery*, 10, 1-106.
- McKim, R. (1972). *Experiences in visual thinking*. Monterey, CA: Brooks/Cole Publishing Company.
- Mental Imagery (2005). *Stanford encyclopedia of philosophy*. Retrieved November 5, 2006 from <http://plato.stanford.edu/entries/mental-imagery/>
- Moran, A. (1993). Conceptual and methodological issues in the measurement of mental imagery skills in athletes. *Journal of Sport Behavior*, 16(3), 156-170.
- Morin, A. (1998). *Imagery and self-awareness: A theoretical note. Theory and review in psychology*. Retrieved October 8, 2006 from <http://gemstate.net/susan/Imagry2.htm>

- Mowl, G. (1981). Predicting achievement in reading fingerspelling: Development of an experimental test. *Journal of the American Deafness and Rehabilitation Association*, 15, 7-9.
- Newell, W., Caccamise, F., Boardman, K., & Holcomb, B. (1983). Adaptation of the language proficiency interview (LPI) to assessing sign communicative competence. *Sign Language Studies*, 12(41), 311-353.
- Onwuegbuzie, A., Bailey, P., & Daley, C. (2001). Cognitive, affective, personality and demographic predictors of foreign-language achievement. *Journal of Educational Research*, 94(1), 3-15.
- Pérez-Fabello, M., & Campos, A. (2007). Influence of training in artistic skills on mental imaging capacity. *Creativity Research Journal*, 19(2 & 3), 227-232.
- Peters, M., Laeng, B., Latham, K., Jackson, M., Zaiyouna, R. & Richardson, C. (1995). A Redrawn Vandenberg & Kuse Mental Rotations Test: Different Versions and Factors that affect Performance. *Brain and Cognition*, 28, 39-58.
- Peterson, R. (2001). Scared to deaf: Language anxiety among ASL students. Published online at [http://www.flagler.edu/about\\_f/deafstudies.html](http://www.flagler.edu/about_f/deafstudies.html) [AN 1813]
- Peterson, R. (2006). The National Consortium of Interpreter Education Centers' 2- to 4-year program transition project. In E. Maroney (Ed.). *Conference of Interpreter Trainers 16th National Convention: A new chapter in interpreter education: Accreditation, research, & technology* (pp. 133-147). Silver Spring, MD: Conference of Interpreter Trainers.
- Pylyshyn, Z. (2003). *Seeing and visualizing*. Cambridge, MA: The MIT Press.
- Quinto-Pozos, D. (2005). Factors that influence the acquisition of ASL for interpreting students. In M. Marschark, R. Peterson, & E. Winston (Eds.). *Sign language interpreting and interpreter education: Directions for research and practice* (pp.159-187). Oxford, England: Oxford University Press.
- Richardson, A. (1969). *Mental imagery*. New York: Springer Publishing Company, Inc.
- Richardson, A. (1977). The meaning and measurement of memory imagery. *British Journal of Psychology*, 68, 29-43.
- Richardson, A. (1994). *Individual differences in imaging: Their measurement, origins, and consequences*. Amityville, NY: Baywood Publishing Company, Inc.
- Robinson, R. (1987). Visual memory and lag time. In M. McIntire (Ed.) *New dimensions in interpreter education: Curriculum & instruction* (pp. 33-46). Chevy Chase, MD: RID Publications.

- Rodway, P., Gillies, K., & Schepman, A. (2006). Vivid imagers are better at detecting salient changes. *Journal of Individual Differences*, 27(4), 218-228.
- Rosen, R. (2004). Beginning L2 production errors in ASL lexical phonology: A cognitive phonology model. *Sign Language & Linguistics*, 7(1), 1-61.
- Rudser, S., & Strong, M. (1986). An examination of personal characteristics and abilities of sign language interpreters. *Sign Language Studies*, 53, 315-331.
- Samuels, M., & Samuels, N. (1975). *Seeing with the mind's eye*. New York: Random House.
- Sawyer, M., & Ranta, L. (2001). Aptitude, individual differences, and instructional design. In P. Robinson (Ed.), *Cognition and second language instruction* (pp. 319-353). Cambridge: Cambridge University Press.
- Schein, J. (1974). Personality characteristics associated with interpreter proficiency. *Journal of Rehabilitation of the Deaf*, 7(3), 33-43.
- Schultz, K. (1991). The contribution of solution strategy to spatial performance. *Canadian Journal of Psychology*, 45(4), 474-491.
- Schweda-Nicholson, M. (2005). Personality characteristics of interpreter trainees: The Myers-Briggs type indicator (MBTI). *The Interpreters' Newsletter*, 13, 109-142.
- Seal, B. (2004). Psychological testing of sign language interpreters. *Journal of Deaf Studies and Deaf Education*, 9(1), 39-52.
- Second Language Testing Foundation (n.d.). *Language aptitude testing*. Retrieved February 20, 2010 from <http://www.2lti.com/htm/LangAptitudeTesting.htm#2>
- Shaw, S., & Hughes, G. (2006). Essential characteristics of sign language interpreting students. *Interpreting*, 8(2), 195-221.
- Shaw, S., Grbic, N., & Franklin, K. (2004). Applying language skills to interpretation: Student perspectives from signed and spoken language programs. *Interpreting: International Journal of Research & Practice in Interpreting*, 6(1), 69-102.
- Sheehan, P. W. (1967). A shortened version of Betts' questionnaire upon mental imagery. *Journal of Clinical Psychology*, 23, 386-389.
- Shepard, R. N., & Metzler, J. (1971). Mental rotation of three dimensional objects. *Science*, 171, 701-703.

- Shipgood, L. & Pring, T. (1995). The difficulties of learning fingerspelling: An experimental investigation with hearing adult learners. *European Journal of Disorders of Communication*, 30, 401-416.
- Sign Language Interpreter Language and Interpreting Aptitude. (n.d.). Language aptitude testing. Retrieved from <http://www.2lti.com/htm/LangAptitudeTesting.htm#2>
- Sparks, R. (2006). Is there a “disability” for learning a foreign language? *Journal of Learning Disabilities*, 39, 544-557.
- Sparks, R., Patton, J., Ganschow, L., & Humbach, N. (2009). Long-term crosslinguistic transfer of skills from L1 to L2. *Language Learning*, 59(1), 203-243.
- Stauffer, L. (1992). Enhancing visualization skills for interpretation between ASL and English. In J. Plant-Moeller (Ed.). *The 12th national Convention of the Registry of Interpreters for the Deaf: Expanding horizons* (pp. 62-80). Silver Spring, MD: RID Publications.
- Stauffer, L., Burch, D., & Boone, S. (1999). A study of the demographics of attendees at the 1997 biennial convention of the Registry of Interpreters for the Deaf, Inc. *Journal of Interpretation*, 1, 105-116.
- Stauffer, L., & Shaw, S. (2006). Personality characteristics for success in interpreting courses: Perceptions of spoken and sign language interpretation students. *Journal of Interpretation*, 1, 11-24.
- Stone, C. (2009). *Sign language interpreter language and interpreting aptitude*. Retrieved online February 21, 2009 from [http://www.dcal.ucl.ac.uk/Research/Interpreter\\_Aptitude.html](http://www.dcal.ucl.ac.uk/Research/Interpreter_Aptitude.html)
- Talbot, K., & Haude, R. (1993). The relation between sign language skill and spatial visualization ability: Mental rotation of three-dimensional objects. *Perceptual and Motor Skills*, 77, 1387-1391.
- Taub, S., Galvan, D., Piñar, P. & Mather, S. (2006a). Gesture and ASL L2 acquisition. In R. M. de Quadros (Ed.). *TISLR9: Theoretical issues in Sign Language Research Conference: Sign languages: Spinning and unraveling the past, present and future* (pp. 639-651). Florianopolis, Brazil: Universidade Federal de Santa Catarina Florianópolis.
- Taub, S., Galvan, D., Piñar, P. & Mather, S. (2006b). Gesture and mental imagery in ASL learning. In R. M. de Quadros (Ed.). *TISLR9: Theoretical issues in Sign Language Research Conference: Sign languages: Spinning and unraveling the past, present and future* (pp. 209-210). Florianopolis, Brazil: Universidade Federal de Santa Catarina Florianópolis.

- Thomas, N. (1999). Are theories of imagery theories of imagination? An active perception approach to conscious mental content. *Cognitive Science*, 23(2), 207-245.
- Timarová, S., & Ungoed-Thomas, H. (2007). Admission testing for interpreting courses. *The Interpreter and Translator Trainer*, 2(1), 29-46.
- UALR Provost's Office. (2008). *What is Act 1014 (four-year graduation agreement)?* Retrieved December 14, 2008 from <http://www.ualr.edu/provost/act1014/about.shtml>
- Vandenberg, S., & Kuse, A. (1978). Mental rotations, a group test of three-dimensional spatial visualization. *Perceptual and Motor Skills*, 47, 599-604.
- Voyer, D., Butler, T., Cordero, J., Brake, B., Silbersweig, D, Stern, E., & Imperto-McGinley, J. (2006). The relation between computerized and paper-and-pencil mental rotation tasks: A validation study. *Journal of Clinical & Experimental Neuropsychology*, 28, 928-239
- Walter, W. (1963). *The living brain*. New York: W. W. Norton & Company, Inc.
- Welles, E. (2004). Foreign language enrollments in United States institutions of higher education, Fall 2002. *ADFL Bulletin*, 35(2-3), 7-26.
- Wilcox, S. (1981). The Myers-Briggs type indicator: Personality types of sign language interpreters. *RID Interpreting Journal*, 1(1), 39-50.
- Wilcox, S. (1992). *Phonetics of fingerspelling*. Amsterdam: John Benjamins.

## APPENDICES

Appendix A:	IRB Approval, University of Arkansas
Appendix B:	IRB Approval, University of Arkansas at Little Rock
Appendix C:	Vividness of Visual Imagery Questionnaire
Appendix D:	Author Permission to Administer the VVIQ
Appendix E:	Permission from Author to Administer the MRT-A
Appendix F:	Sample from Vandenberg Test of Mental Rotation (as a representation of the MRT-A)
Appendix G:	Sign Communication Proficiency Interview (SCPI) Rating Scale



## Appendix A



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### Research Support and Sponsored Programs Institutional Review Board

May 18, 2009

#### MEMORANDUM

TO: Linda Stauffer  
Richard Roessler

FROM: Ro Windwalker  
IRB Coordinator

RE: New Protocol Approval

IRB Protocol #: 09-05-601

Protocol Title: *The Relationship among Beginning and Advanced American Sign Language Students and Credentialed Interpreters across Two Domains of Visual Imagery: Vividness and Manipulation*

Review Type: ☒ EXEMPT ☐ EXPEDITED ☐ FULL IRB

Approved Project Period: Start Date: 05/15/2009 Expiration Date: 05/14/2010

Your protocol has been approved by the IRB. Protocols are approved for a maximum period of one year. If you wish to continue the project past the approved project period (see above), you must submit a request, using the form *Continuing Review for IRB Approved Projects*, prior to the expiration date. This form is available from the IRB Coordinator or on the Compliance website (<http://www.uark.edu/admin/rsspinfo/compliance/index.html>). As a courtesy, you will be sent a reminder two months in advance of that date. However, failure to receive a reminder does not negate your obligation to make the request in sufficient time for review and approval. Federal regulations prohibit retroactive approval of continuation. Failure to receive approval to continue the project prior to the expiration date will result in Termination of the protocol approval. The IRB Coordinator can give you guidance on submission times.

If you wish to make any modifications in the approved protocol, you must seek approval *prior* to implementing those changes. All modifications should be requested in writing (email is acceptable) and must provide sufficient detail to assess the impact of the change.

If you have questions or need any assistance from the IRB, please contact me at 120 Ozark Hall, 5-2208, or [irb@uark.edu](mailto:irb@uark.edu).

## Appendix B



### MEMORANDUM

TO: Linda K. Stauffer

CC: Rhiannon Morgan, Research Compliance Officer

FROM: Dr. Elisabeth Sherwin, IRB Chair  
UALR Institutional Review Board

DATE: 22 May 2009

RE: IRB Request for Expedited Review

---

Thank you for your recent Institutional Review Board Request for Expedited Review (Protocol # 09149) titled "The Relationship Among Beginning and Advanced American Sign Language Students and Credentialed Interpreters Across Two Domains of Visual Imagery". We have reviewed this request and find that it meets the IRB's criteria for protection of human participants. Your project has IRB approval from today until **5/21/2010** and you are free to proceed with data collection.

If this study continues unchanged for more than one year, you will need to submit a Request for Continuing Review. If this study continues for more than one year and there are changes to the research design or data that is collected, you will need to submit a Request for Review of Modification or Amendment to Approved Research form.

**\*\* This message is a reminder that you may begin your research project.**

Best of luck with your study.

2801 South University Little Rock, Arkansas 72204  
(O) 501.569.8474 (F) 501.371.7614  
[www.ualr.edu/orsp](http://www.ualr.edu/orsp)

## Appendix C

ID: \_\_\_\_\_

SCORE: \_\_\_\_\_

### VIVIDNESS OF VISUAL IMAGERY QUESTIONNAIRE (VVIQ)

#### TOTAL SCORES

(a) Eyes open =

(b) Eyes closed =

Total (a + b) =

Professor David Marks  
City University, London

*Visual Imagery* refers to the ability to visualize, that is, the ability to form mental pictures, or to “see in the mind’s eye.” Marked individual differences have been found in the strength and clarity of reported visual imagery and these differences are of considerable psychological interest.

The aim of this test is to determine the vividness of your visual imagery. The items of the test will possibly bring certain images to your mind. You are asked to rate the vividness of each image by reference to the 5-point scale given below. For example, if your image is “vague and dim” then give it a rating of 4. After each item write the appropriate number in the box provided. Before you turn to the items on the next page, familiarize yourself with the different categories on the rating scale. Throughout the test, refer to the rating scale when judging the vividness of each image. Try to do each item separately, independent of how you may have done other items.

Complete all items for images obtained with the eyes or closed. Try to rate each item independent of the other.

#### Rating Scale

*The image aroused by an item might be:*

Perfectly clear and as vivid as normal vision	rating 1
Clear and reasonably vivid	rating 2
Moderately clear and vivid	rating 3
Vague and dim	rating 4
No image at all, you only "know" that you are thinking of an object	rating 5

## Rating Scale

Perfectly clear and as vivid as normal vision	rating 1
Clear and reasonably vivid	rating 2
Moderately clear and vivid	rating 3
Vague and dim	rating 4
No image at all, you only "know" that you are thinking of an object	rating 5

.....

**WITH EYES OPEN OR CLOSED:** In answering items 1 to 4, think of some relative or friend whom you frequently see (but who is not with you at present) and consider carefully the picture that comes before your mind's eye.

- 1 The exact contour of face, head, shoulders and body.
  - 2 Characteristic poses of head, attitudes of body etc.
  - 3 The precise carriage, length of step, etc. in walking.
  - 4 The different colors worn in some familiar clothes.
- .....

**WITH EYES OPEN OR CLOSED:** Visualize the rising sun. Consider carefully the picture that comes before your mind's eye.

- 5 The sun is rising above the horizon into a hazy sky
  - 6 The sky clears and surrounds the sun with blueness
  - 7 Clouds. A storm blows up, with flashes of lightening
  - 8 A rainbow appears
- .....

**WITH EYES OPEN OR CLOSED:** Think of the front of a shop which you often go to. Consider the picture that comes before your mind's eye.

- 9 The overall appearance of the shop from the opposite side of the road.
- 10 A window display including colors, shape and details of individual items for sale.
- 11 You are near the entrance. The color, shape and details of the door
- 12 You enter the shop and go to the counter. The counter assistant serves you. Money changes hands.

### **Rating Scale**

Perfectly clear and as vivid as normal vision	rating 1
Clear and reasonably vivid	rating 2
Moderately clear and vivid	rating 3
Vague and dim	rating 4
No image at all, you only "know" that you are thinking of an object	rating 5

.....

**WITH EYES OPEN OR CLOSED:** Finally, think of a country scene which involves trees, mountains and a lake. Consider the picture that comes before your mind's eye.

- |    |   |                      |
|----|---|----------------------|
| 13 | The contours of the landscape                                 | <input type="text"/> |
| 14 | The color and shape of the trees                              | <input type="text"/> |
| 15 | The color and shape of the lake                               | <input type="text"/> |
| 16 | A strong wind blows on the tree and on the lake causing waves | <input type="text"/> |

## Appendix D

### Author Permission to Administer the VVIQ

**Date:** Mon, 09 Oct 2006 22:28:55 +0100  
**From:** "Marks, David" <D.Marks@city.ac.uk>  
**Subject:** RE: Seeking Permission to Administer VVIQ, 2nd Request  
**To:** "Linda K. Stauffer" <lkstauffer@ualr.edu>  
**Thread-topic:** Seeking Permission to Administer VVIQ, 2nd Request  
**Thread-index:** AcbrGmjYrJoSJEpfQtq4+CnAvQpu9AAz4PJN  
**X-City-MailScanner-Information:** Please contact the Response Centre for more information  
**X-City-MailScanner:** Found to be clean  
**X-City-MailScanner-From:** d.marks@city.ac.uk  
**X-Virus-Defs:** 0.86.2/2016/Mon Oct 9 11:58:54 2006  
**Original-recipient:** rfc822;lkstauffer@ualr.edu

#### please go ahead

-----Original Message-----

**From:** Linda K. Stauffer [<mailto:lkstauffer@ualr.edu>mailto:lkstauffer@ualr.edu]  
**Sent:** Sun 10/8/2006 9:35 PM  
**To:** Marks, David  
**Subject:** Seeking Permission to Administer VVIQ, 2nd Request

Professor Marks,

I am an Assistant Professor in the Interpreter Education Program (American Sign Language/English) at the University of Arkansas at Little Rock, and also a doctoral student at the University of Arkansas (Fayetteville). I emailed you last week, but have not hear back, so I am sending this request again.

I would like your permission to use the VVIQ to administer to sign language students in our ASL I, II, III and IV for a one-time project for my Multiple Regression class. I have been interested in visualization for over 20 years, presenting workshops around the US on the topic for sign language interpreters. The idea of measuring visual vividness is quite intriguing to me.

I have seen the VVIQ posted on the web, and in the Appendix of published articles. It does not appear to be for sale, but I want to have your permission before I more forward. The project will go through IRB approval.

Please let me know if I have your permission to administer the VVIQ for this one project to our sign language students, and any requirements you may have for granting such permission. I will, of course, be happy to share the results and my class paper with you.

I appreciate your consideration and look forward to hearing from you soon.

Sincerely,  
Linda K. Stauffer, M.Ed., CSC, OTC  
Assistant Professor  
Interpreter Education Program  
University of Arkansas at Little Rock  
2801 S. University Ave.  
Little Rock, AR 72212-2125  
501-569-8508 office  
501-569-8129 fax

## Appendix E

### Permission from Author to Administer the MRT-A

Original-recipient: rfc822;lkstauffer@ualr.edu  
X-ASG-Debug-ID: 1213017594-109702a40000-dL4rGM  
X-Barracuda-URL: http://mailfilter.ualr.edu:80/cgi-bin/mark.cgi  
**Date: Mon, 09 Jun 2008 09:19:57 -0400 (EDT)**  
**From: Michael Peters <mpeters@uoguelph.ca>**  
**To: "Linda K. Stauffer" <lkstauffer@ualr.edu>**  
X-ASG-Orig-Subj: Re: Redrawn version of the Vandenberg  
Subject: Re: Redrawn version of the Vandenberg  
X-Originating-IP: [131.104.197.193]  
X-Barracuda-Connect: gigi.cs.uoguelph.ca[131.104.94.210]  
X-Barracuda-Start-Time: 1213017596  
X-Barracuda-Encrypted: AES256-SHA  
X-Barracuda-Virus-Scanned: by UALR Mail Filter at ualr.edu  
X-Barracuda-Spam-Score: -1001.00  
X-Barracuda-Spam-Status: No, SCORE=-1001.00 using per-user scores of  
TAG\_LEVEL=3.5 QUARANTINE\_LEVEL=4.0 KILL\_LEVEL=9.0

Hi, Linda - here is the test, answer key and information letter.

Best, Michael

Attachment converted: Macintosh HD:MRA.pdf (PDF /«IC») (000F0A1E)  
Attachment converted: Macintosh HD:abcdcovertxt.rtf (TEXT/«IC») (000F0A1F)  
Attachment converted: Macintosh HD:informationletter.rtf (TEXT/«IC») (000F0A20)

---

----- Original Message -----

**Sent: Friday, June 6, 2008 3:17:40 PM GMT -05:00 US/Canada Eastern**  
**To: Michael Peters <mpeters@uoguelph.ca>**  
**From: "Linda K. Stauffer" <lkstauffer@ualr.edu>**  
**Subject: Re: Redrawn version of the Vandenberg**

Dr. Peters,

Yes, I understand the criticality of this not getting into general circulation and I agree that I will not share it in any way with any person or library or institution other than my dissertation committee. I will delete the pdf as soon as I have a master.

I appreciate your response and sharing this with me for my research.

Sincerely

Linda K. Stauffer, M.Ed., CSC, OTC  
Program Coordinator  
Interpreter Education Program

Department of Counseling, Adult and  
Rehabilitation Education  
University of Arkansas at Little Rock  
2801 S. University Ave.  
Little Rock, AR 72204-1099  
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(501) 569-8508 office  
(501) 569-8129 fax  
(501) 569-3169 and (501) 569-8512 VP (alert first)  
144.167.31.211 IP (alert first)  
lkstauffer@ualr.edu  
<http://www.ualr.edu/ba/INAS>

---

Original-recipient: rfc822;lkstauffer@ualr.edu  
X-ASG-Debug-ID: 1212782462-2d19001c0000-dL4rGM  
X-Barracuda-URL: <http://mailfilter.ualr.edu:80/cgi-bin/mark.cgi>  
**Date: Fri, 06 Jun 2008 16:00:48 -0400 (EDT)**  
**From: Michael Peters <mpeters@uoguelph.ca>**  
**To: "Linda K. Stauffer" <lkstauffer@ualr.edu>**  
**X-ASG-Orig-Subj: Re: Redrawn version of the Vandenberg**  
Subject: Re: Redrawn version of the Vandenberg  
X-Originating-IP: [131.104.197.193]  
X-Barracuda-Connect: gigi.cs.uoguelph.ca[131.104.94.210]  
X-Barracuda-Start-Time: 1212782463  
X-Barracuda-Encrypted: AES256-SHA  
X-Barracuda-Virus-Scanned: by UALR Mail Filter at ualr.edu  
X-Barracuda-Spam-Score: 0.28  
X-Barracuda-Spam-Status: No, SCORE=0.28 using per-user scores of TAG\_LEVEL=3.5  
QUARANTINE\_LEVEL=4.0 KILL\_LEVEL=9.0 tests=MAILTO\_TO\_SPAM\_ADDR  
X-Barracuda-Spam-Report: Code version 3.1,  
rules version 3.1.52552      Rule breakdown below      pts rule name  
description      -----  
-----  
0.28 MAILTO\_TO\_SPAM\_ADDR  
URI: Includes a link to a likely spammer email

Hi, Linda -

You can use this but it is important that you guarantee that the test  
is only used for your research and does not find its way into the  
general libraries of your institutions or in general circulation.  
In addition you must promise to delete the pdf as soon as you  
have a master that can be used to run of copies for your study.  
Wider circulation would invalidate the test.  
Once you guarantee this, I can send the test.  
Best, Michael Peters

Michael Peters, PhD,  
Professor  
Dept. Psychology,  
University of Guelph,  
Guelph, ON, Canada N1G 2W1



Phone: (519) 824-4120 / ext. 53597 or 58530  
FAX: (519) 837-8629,  
e-mail: mpeters@uoguelph.ca  
Editor: Laterality (1997-2007), Editorial Board 2007--  
Editorial Board: Evolutionary Psychology  
Editorial Advisory Board: Neuropsychologia, 1996-

---

----- Original Message -----

From: "Linda K. Stauffer" <lkstauffer@ualr.edu>  
To: mpeters@uoguelph.ca, cbatti01@uoguelph.ca  
Sent: Friday, June 6, 2008 2:15:52 PM GMT -05:00 US/Canada Eastern  
Subject: Redrawn version of the Vandenberg

Drs. Peters and Battista:

I am a Ph.D. seeking student at the University of Arkansas. I am ABD and currently developing my dissertation proposal to evaluate the relationship between students' visual imagery ability and status in university level American Sign Language (ASL) and ASL/English interpreting classes. I am looking at Marks Vividness of Visual Imagery Questionnaire (VVIQ), but also want a more objective test of visual manipulation as per the two part definition is use for visual imagery (ability to create and manipulate visual imagery).

At this time, I believe the Vandenberg Test of Mental Rotation has high applicability to sign language interpreting and I would like to access a copy of the basic MRTA to assess for use in my dissertation research.

I am also a faculty member and program coordinator of the interpreting program at the University of Arkansas-Little Rock.

Please let me know how I can access this instrument. Thank you.

Sincerely,  
Linda

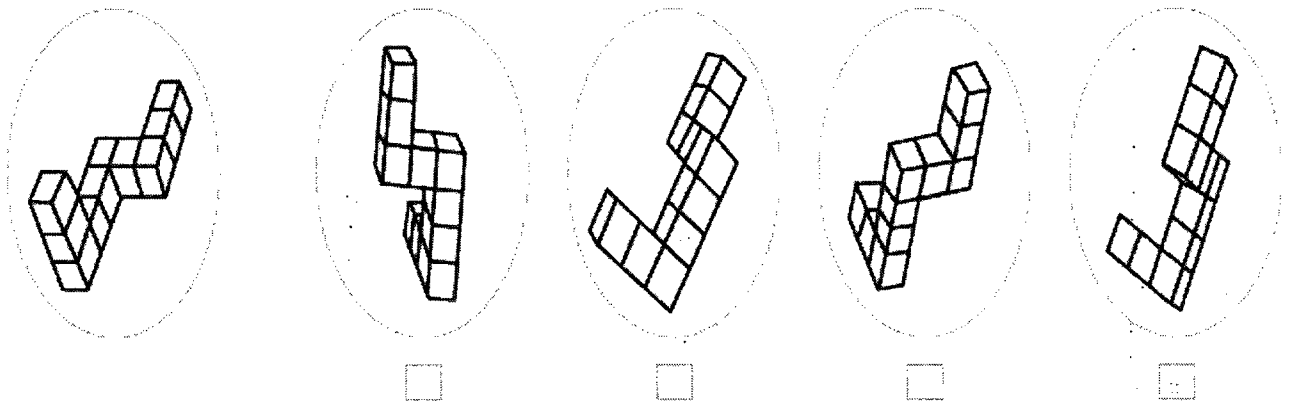
--

Linda K. Stauffer, M.Ed., CSC, OTC  
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(501) 569-3169 and (501) 569-8512 VP (alert first)  
144.167.31.211 IP (alert first)  
lkstauffer@ualr.edu  
<http://www.ualr.edu/ba/INAS>

## Appendix F

Sample from Vandenberg Test of Mental Rotation (as a representation of the MRT-A)

### VANDENBERG MENTAL ROTATIONS TEST



Figures Courtesy Of Matthew S. McGlone

Here is one of the questions from the Vandenberg Mental Rotation Test, used to measure one aspect of mathematical reasoning. Check the boxes under the two figures that are identical to the one on the far left (but seen from different angles). Men are three times as likely as women to do well on this type of problem.

ANSWER: The second from the left and the one on the far right are identical to the target object (the one on the far left). If you number them 1 through 5 from left to right, 2 and 5 are identical to 1.

## Appendix G

### SIGN COMMUNICATION PROFICIENCY INTERVIEW (SCPI) RATING SCALE

<b>RATINGS</b>	<b>DESCRIPTIONS</b>
<b>Superior Plus</b>	<b>Able to have a fully shared and natural conversation, with in-depth elaboration for both social and work topics.</b> All aspects of signing are native-like.
<b>Superior</b>	<b>Able to have a fully shared conversation, with in-depth elaboration for both social and work topics.</b> Very broad sign language vocabulary, near native-like production and fluency, excellent use of sign language grammatical features, and excellent comprehension for normal signing rate.
<b>Advanced Plus</b>	Exhibits some superior level skills, but not all and not consistently.
<b>Advanced</b>	<b>Able to have a generally shared conversation with good, spontaneous elaboration for both social and work topics.</b> Broad sign language vocabulary knowledge and clear, accurate production of signs and fingerspelling at a normal/near-normal rate; occasional misproductions do not detract from conversation flow. Good use of many sign language grammatical features and comprehension good for normal signing rate.
<b>Intermediate Plus</b>	Exhibits some advanced level skills, but not all and not consistently.
<b>Intermediate</b>	<b>Able to discuss with some confidence routine social and work topics within a conversational format with some elaboration; generally 3-to-5 sentences.</b> Good knowledge and control of everyday/basic sign language vocabulary with some sign vocabulary errors. Fairly clear signing at a moderate signing rate with some sign misproductions. Fair use of some sign language grammatical features and fairly good comprehension for a moderate-to-normal signing rate; a few repetitions and rephrasing of questions may be needed.
<b>Survival Plus</b>	Exhibits some intermediate level skills, but not all and not consistently.
<b>Survival</b>	<b>Able to discuss basic social and work topics with responses generally 1-to-3 sentences in length.</b> Some knowledge of basic sign language vocabulary with many sign vocabulary and/or sign production errors. Slow-to-moderate signing rate. Basic use of a few sign language grammatical features. Fair comprehension for signing produced at a slow-to-moderate rate with some repetition and rephrasing.
<b>Novice Plus</b>	Exhibits some survival level skills, but not all and not consistently.
<b>Novice</b>	<b>Able to provide single sign and some short phrase/sentence responses to basic questions signed at a slow-to-moderate rate with frequent repetition and rephrasing.</b> Vocabulary primarily related to everyday work and/or social areas such as basic work-related signs, family members, basic objects, colors, numbers, names of weekdays, and time. Production and fluency characterized by many sign production errors and by a slow rate with frequent inappropriate pauses/hesitations.
<b>No Functional Skills</b>	<b>(May be) Able to provide short single sign and "primarily" fingerspelled responses to some basic questions signed at a slow rate with extensive repetition and rephrasing.</b>

